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A Methodology to Consolidate Transit Stops for Enhancing Transit Users Travel Times

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Dedication

This work is dedicated to my wife

Rowshan Ara

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First, I am grateful to the almighty Allah whose blessings were always with me throughout my entire life, which helps me to overcome the most difficult circumstances.

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ABSTRACT

This study develops a methodology to consolidate transit stops. It develops a mathematical model and a program which takes stop consolidation decision(s) according to users travel time savings and desired accessibility. The model iterates until the users travel time savings are maximized. The study tests this mathematical model in different hypothetical scenarios. Six factors (*distance between stops*, *passengers' activity*, *average cruising speed*, *maximum walkable distance*, *frequency of service* and *percentage of decreased passengers*) with multiple levels were set to build the scenarios. Three responses (percentage of consolidated stops, percentage of travel time savings and percentage of operating time savings) were observed. The findings showed that the *distance between the stops* and the *maximum walkable distance* are the most influential factors. The *passengers' activity* and the *percentage of decreased passengers* are also found to be influential. The *average cruising speed* and the *frequency of service* has very little influence on the response variables. The study also shows how the interactions of the factors influence the consolidation decision. Finally the model is tested on two routes (route 900 and 930) of Al Ain City public bus service. It shows that 30 and 36 stops out of 98 and 126 stops can be consolidated in route 900 and 930 respectively. This can save a considerable amount of users travel time and operating time. In monetary value, the saving is about 865,000 US$ and 1,100,000 US$ per year for route 900 and 930 respectively.

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INTRODUCTION

1.1 Problem Identification

Public transit plays a very important role in the urban transportation planning and management. It is not only considered as a cheap means of transportation, but also considered as efficient and time saving mode. In many cities, public transportation is given priority over private cars. Many transit systems are proven to be more time saving than private cars in many cities. Beside this, public transportation is gaining its share in many cities due to the growing congestion, rise in the fuel price and more awareness about environment.

To cope with the continuous demand, traffic growth and competition, transit systems needs to be efficient. One of the important efficiency indicators of transit performance is the trip travel time. High travel time often discourages passengers to use that mode. Recent study (RTTSRC, 2009; Hassan et al. 2012) indicated moderate satisfaction levels of the service by the transit users in Al Ain and Abu Dhabi. One of the main concerns that users had is the long travel times on the routes. For example, in Al Ain, average travel time for a single trip of route 900 (to Hili Park) is 1hour 13 minutes. This route covers about 30 kilometer of distance and with an average travel speed of 24 kilometer per hour. The long travel time is particularly attributed to the high number of transit stops (52), especially within the town center (15 stops in 5.8 kilometer).

A number of strategies have been developed and advocated in literature to reduce the transit trip timing. Stop consolidation is one of the potential promising strategies to reduce the transit trip time. It can reduce the headway and fleet size, which saves the operating cost of the agency. It also increases reliability and decreases the riding time of the through passengers. But at the same time, it may reduce accessibility and may also

increase the walking time of the passengers. Some of these factors (e.g. reliability, accessibility, walking time and riding time, cost savings) are addressed sufficiently in different research, but, some other factors (such as frequency of service, travel speed, passengers travel time savings) are not addressed adequately. There is a need to investigate all these factors comprehensively in taking consolidation decision. There is also a deficiency in understanding the effects of different factors on the stop consolidation decision (whether to consolidate a stop or not?). This research investigates various factors comprehensively and develops a procedure to systematically investigate the transit stops for consolidation. It also explores the effects of different factors on stop consolidation.

1.2 Aim and Objective of the Study

The main aim of this study is develop a framework and methodology for transit stop consolidation.

The particular objectives of this study are:

- To develop a methodology to consolidate transit stops to enhance the transit users travel time.
- To test this method in various hypothetical scenarios and to determine the important factors of potential impact on the consolidation decision(s).
- To test this method using real data of a transit network (a case study).

1.3 Study Tasks

The study tasks can be summarized as follows

- Investigating the earlier works in stop consolidation process
- Developing an algorithm for consolidating stops by optimizing transit user travel time
- Developing a model to assess stop consolidation opportunities along existing transit routes
- Developing a simulator to model different hypothetical scenarios and assess the effect of factors involved in the consolidation process
- Testing the model in a real transit network.

1.4 Study Approach

The methodology of the study follows the standard steps which includes setting up of objectives, literature review, model development, data collection, analysis and recommendations. Figure 1.1 shows the major steps of the study. Details of these steps are discussed below.

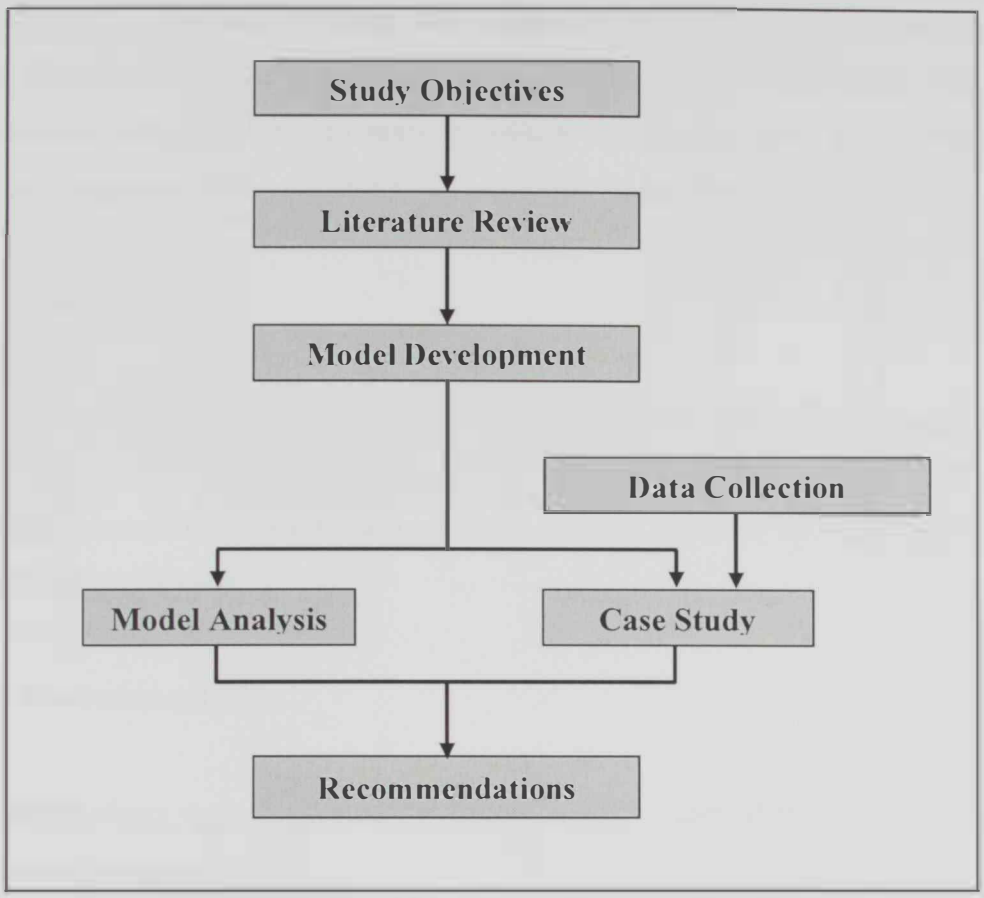


Figure1.1: Flow Diagram of Different Study Task

1.4.1 Literature review

Related books, articles, papers, and thesis were thoroughly and critically reviewed. Various stop consolidation criteria and factors were identified from the literature.

1.4.2 Model Development

A model was developed to calculate the potential users travel time savings due to transit stops consolidation. In the process of model development, other related models or

theories were reviewed and integrated where necessary. Finally, the devised model was coded in Excel VBA environment. The model can be used to decide which transit stop(s) can be consolidated to enhance transit users travel time while maintaining comfortable levels of accessibility.

1.4.3 Data Collection

Data of Al Ain City Bus Network were collected from a secondary source (RTTSRC, 2009). The data was used in the case study of the model. The case study data includes stop locations, distance between stops, passenger activity (boarding and alighting), travel time, and frequency of service along two particular routes (routes 900 and 930).

1.4.4 Analysis

The devised model was analyzed in two stages. In the first stage, the developed simulator was used to model various hypothetical scenarios, and to analyze the contributing factors of the stop consolidation. In the second stage, two bus routes of Al Ain City Bus Service Network were analyzed.

1.4.5 Recommendation

Recommendations were suggested for further improvement of the model. Some related study was also recommended.

1.5 Organization of the Thesis

The thesis consists of six chapters. Chapter 1 includes the problem identification, aim, objective and tasks of the study. It also highlights briefly the methodology adopted for the study.

Chapter 2 includes the review of the related literatures. It includes different concepts of stop consolidation, advantage and disadvantage of consolidation, and the important factors associated with consolidation. It also describes the concepts and components of

travel time which include the transit travel time (or run time), transit user travel time and value of travel time.

Chapter 3 describes the development of the model for transit user travel time savings. It describes the model structure and its components. The chapter also explains the theoretical basis of the model.

In Chapter 4, the model is tested in different hypothetical scenarios to capture the primary factors of significant contributions to the transit users travel time savings. An experimental design methodology is used for this analysis.

Chapter 5 describes the case study to check the performance of the model. Two bus routes (route 900 and route 930) are chosen from Al Ain City public bus service operated by the Department of Transport – Abu Dhabi (DoT). It analyzes the model outcomes for these two cases. The chapter provides detailed analysis of applying the discussed model to these two routes.

Chapter 6 describes the notable strengths and limitations of the model. It also produces some recommendations to improve the model. Future study opportunity in this field is also discussed.

Chapter 2

LITERATURE REVIEW

2.1 Stop Consolidation

In Transit planning, stop consolidation refers to a process of merging, eliminating or re-locating stops. The main goals of stop consolidation are to increase the transit trip speed, reduce travel time, increase reliability, optimize bus stop spacing, improve passenger facilities and improve pedestrian and traffic safety.

2.1.1 Advantages and Disadvantages of Stop Consolidation

Stop consolidation has the most direct effect on travel time. This is due to the fact that each stop is characterized by certain delay elements such as deceleration and acceleration time, dwell time, time taken in the open and close doors and re-entering traffic delay. Thus, consolidation can decrease the travel time by saving these delay times. This will reduce the operating cost (Li and Bartini, 2008; Furth et al., 2007; Furth and Rahbee, 2000) and even reduce the fleet size (Ibeas et al., 2010; Saka, 2001).

Removing bus stops also reduces variations in travel times because there are fewer opportunities for delay. In his research, Kehoe (2004) proved that stop consolidation can improve reliability by reducing the number of late trips. More proficient scheduling with less recovery time can be achieved with an improved reliability (Furth and Muller, 2007). Reliable schedule reduces passenger waiting time and frustration (Furth and Muller, 2006). The "bunching effect" (two or more transit vehicles along the same route, scheduled to be evenly spaced, running in the same location at the same time) can also be decreased with improved reliability.

In stop consolidation, some users are affected as the average walking distance and time are increased. Moreover, it may reduce the catchment area of the stops and thus reduces accessibility to some users. This may conceptually lead to reduced ridership after consolidation. Nonetheless, a smart consolidation approach may show no adverse impact on ridership (El-Geneidy et al., 2006; Kehoe, 2004). Rather, it may increase the ridership by improving the reliability and travel time (Vuchic, 2005; Kehoe, 2004). As a result, user satisfaction can also be increased (El-Geneidy and Surprenant-Legault, 2010; Hensher et al., 2003).

2.1.2 Factors of Stop Consolidation

Several factors are pointed out by the researchers which should be considered before choosing a stop to consolidate. Stop spacing and accessibility are considered to be most important of all. Other factors include transit demand (normally represented as ridership), stopping pattern, transfer stops, etc. These factors are discussed below.

2.1.2.1 Stop Spacing

Spacing between the stops is the main determining factor to consolidate stops. Bus stop location has impacts on riding time, operating cost and walking time. As a result, it needs tradeoff between the costs and benefits of more frequent stops (Furth and Rahbee, 2000). Many researchers work on determining the geographic location of stops (Ibeas et al., 2010; Furth et al., 2007) and distance between stops (Oliveira et al., 2011; Li, 2011; Gong et al., 2011; Ibeas et al., 2010, Li and Bartini, 2008; Oliveira et al., 2008; Chien and Qin, 2004; Saka, 2001; Furth and Rahbee, 2000; Feng et al., 2012; Vuchic and Newell, 1968).

Stop Spacing Studies

Vuchic and Newell (1968) are the pioneer researchers who presented an analytical method to determine stop spacing. They assumed a uniform population distribution along the line to find out the optimum spacing by minimizing the total passenger travel time. The problem was formulated as an optimization problem where the alignment of the transit line between two points (source and destination) are given. The positions of the intermediate stations are to be determined optimally based on the travel time cost. Stop spacing is optimized when the marginal changes in transit user's access time and in-

vehicle times become balanced. A hypothetical route, assuming uniform population density was investigated and optimum stop spacing was derived in their study. The study results show that transits like commuter rail, with large vehicle capacity and passenger loads would be best served with fewer stops.

Wirasinghe and Ghoneim (1981) defined optimal spacing as a problem to minimize costs. These costs include users' cost coming from access, egress, and in-vehicle time cost. Cost also includes transit operating cost and the cost of building and maintaining stops. They presented a heuristic approach using continuum approximation and calculus to optimize stop spacing by minimizing passengers' travel time.

Saka (2001) extended this line of research further by demonstrating that proper spacing of stops can significantly improve the quality of transit service by decreasing travel time, headway, fleet size and capital cost. His mathematical model is derived from the fundamental relationships among velocity, uniform acceleration or deceleration, and displacement, with the average bus operating speed, headway, required fleet size and potential system capacity. Challuri (2006) pointed out two important drawbacks of this model: too many significant sources of delays is grouped in 'miscellaneous delay' category, and "limited applicability", as it cannot be used in well-established bus routes, though it can be useful for planning purpose.

Furth and Rahbee (2000) used a discrete model combining Geographic Information System (GIS) and dynamic programming. They applied the model to a heavily used route in the Massachusetts Bay Transportation Authority system to determine the optimal number and location of bus stops. They distributed the demand (observed at the existing stops), to the cross and parallel streets in the route service area. The objective of dynamic programming is to minimize passengers' time costs and the operating costs of the route. The model results gave preference to larger stop spacing near the centre core of the route and smaller spacing near the terminals. The logic behind this is that, near the core area, there are normally more passengers on-board, and if stop spacing is more they will not be delayed by the extra stops. The model suggested only 19 stops out of 37 existing stops. The average stop spacing increased from 200 meters to 400 meters, resulting in passengers' average walking time increase by 0.6 minutes. The passengers' average in-vehicle times declined by 1.8 min and the average vehicle running times declined by 4.3

min per trip. In the optimum stop spacing scenario, the combined cost savings of the passengers and the operating agency was estimated as $132 per hour.

Furth et al. (2007) pointed out a major drawback of the traditional models as these models assumed uniform demand density or/and unobstructed walking paths while calculating walking distances. To calculate walking distance accurately, they used land parcel information database and walkway network. The parcel database is converted to a transit demand database reflecting each parcel's ability to produce and attract public transit. They used the ITE (Institute of Transportation Engineers) Trip Generation and Distribution Manual to calculate the transit trip demand of each parcel according to the land use. The walkway network modeled the entire feasible walking paths from the parcels to the transit stops. Finally, walking distances were calculated as the nearest walking distance from a parcel to a stop.

Chien and Qin (2004) proposed a mathematical model to determine optimum number of stops and location by minimizing total cost. A realistic demand distribution based on a general street configuration was considered. The concept of non-additive time cost was also applied in the development of the model.

Ibeas et al. (2010) proposed an optimal bus stop location and spacing model to minimize the social cost of all the transport system, taking into account the possible variations in demand due to the different locations for the bus stops, the interaction with private traffic, congestion within the public transport system and the socio-demographic characteristics of each zone in the study area. They applied this model to the transit system of the Santander City and found the optimal stop spacing (between 360 meters and 780 meters).

Li and Bertini (2008) estimated the average stop spacing (372 meters or 1222 feet) by their model using the Bus Dispatch System Data (BDS) of a transport provider in Portland. The aim of their model is to minimize the operating cost while maintaining a high degree of transit accessibility.

Oliviera et al. (2008) designed a model comprising non-linear programming and heuristics to optimize bus stop spacing by minimizing users' average travel time. They employed the model in a bus route in the Brazilian city Sao Paulo. An average optimum

spacing of 850 meters was estimated, a much higher value than the actual average of 250 meters. The model resulted in optimum number of stops as 19 (original number is 70), which reduces the travel time by 25%.

Alonsoa et al. (2011) proposed a bi-level optimization model, which includes a modal split function in a lower level and a social cost minimization function on the upper level. The model applied in different range of demand levels (very low to high congestion). The results show that, low demand produce higher stop spacing while high demand needs lower stop spacing.

Spacing Standards

A study by Furth and Rahbee (2000) found that 95 out of 111 responding U.S. agencies have stop-spacing guidelines. About half of these agencies recommend spacing of 200 to 270 meter and closer spacing in business districts. El-Geneidy et al. (2006) claimed that the standards are hardly uniform as they have quite a large range. Table 2.1 shows some standards followed/suggested by some U.S. agencies. Furth and Rahbee (2000) observed that the U.S. cities have many closely spacing stops (seven to eight per mile) than the European cities (three to four per mile). They found the optimum spacing to be around 400 meters. Saka (2001) also suggested similar spacing.

Table 2.1 Stop Spacing Standards for Different Service Environments

Service Environment	TriMet (feet)	TCRP Report 19 (feet)	NCHRP 69 (feet)
High density (80+ unites/acre), CBD	---	300-1000	440-528
Fully developed residential area (22 to 80 units/acre)	780	500-1200	660-880
Low density residential (4 to 22 unites/acre)	1000	600-2500	1056-2640
Rural (less than 4 unites/acre)	As needed	650-2640	1320-2640

Source: (El-Geneidy et al., 2006)

KFH Group Inc. (2009) prepared the guidelines for the design and placement of transit stops for Washington Metropolitan Area Transit Authority. They indicated: "*bus stops*

should be spaced closely enough that passengers can walk to them easily, but far enough apart to allow for greater bus efficiencies". Inspired from the work of Furth and Rahbee (2000), they recommended four to five bust stops per mile for the "Local Bus Service". For the "Enhanced Service/Limited Stop Service" the recommended spacing is two to three stops per mile.

2.1.2.2 Accessibility

According to Wikipedia (2012), "*accessibility is the degree to which a product, device, service, or environment is available to as many people as possible. Accessibility can be viewed as the ability to access and benefit some system or entity.*" In transportation planning it can be defined as the ease of reaching destinations. Often, transit researchers measured accessibility in terms of service area coverage which is usually determined by users' willingness to walk (Biba et al., 2010; Murray and Wu, 2003; Zhao et al., 2003; O'Sullivan and Morall, 1996).

Walking Distance Standards

Location of a transit stop is vital for its passengers. It should be located at a convenient distance from passenger's origin and destination. Distance is particularly a factor for the pedestrian choice to avail a mode. For park and ride passengers (car and cyclists), the parking facility is much important than the distance. As the major portion of stops is designed for the walking passengers, the average distance of willingness to walk is considered to determine the service area or the accessibility.

The Transit Oriented Development Committee of Fairfax County, Virginia researched the walking distance compiling the standards followed by different authorities (TOD, 2006). Table 2.2 compiles the standards suggested by several other researchers as well. O'Sullivan and Morrall (1996) conducted a study to determine actual walking distance of Light Rail Transit (LRT) stations in Calgary, Canada. They indicated that, people use to walk further to reach a LRT station than a bus stop. They found that the average walking distance to suburban stations is 649 meters with the 75^{th}-percentile distance of 840 meters. At CBD stations the average walking distance is 326 meters and the 75th-percentile distance is 419 meters. In another study for bus stops, it was found that the average walking distance is 327 meters and the 75^{th}-percentile distance is 450 meters (Lam and Morrall, 1982). Gruen, (1964) developed a table (Table 2.3) to illustrate people's tolerance for walking according to the physical environment of the walking path.

Table 2.2 Average Distance of Walking for Transit Service

Reference	Jurisdiction / Study area	Transit Type	Standard (meters)
TOD, 2006	Maryland	Bus	457
	Kansas City, Missouri	Bus	457
	New Jersey	Bus	400
	Ontario	Bus	400
	NY, CT, NJ Tri-metro area	Bus	400
	Snohomish City, Washington	Bus	300
Lam and Morall, 1982	Calgary, Canada	Bus	327 - 450
El-Geneidy et al., 2010	Montréal, Canada	Bus Commuter Rail	550 - 660 1095 - 1219
O'Sullivan and Morrall, 1996	Calgary, Canada	LRT, CBD LRT, Sub-Urban	326 - 419 649 - 840

Table 2.3 People's Tolerance for Walking in Different Eenvironment

Environment	Walking Time (minutes)	Walking Distance	
		feet	meters
In a highly attractive, completely weather-protected and artificially climatized environment	20	5,000	1,524
In a highly attractive environment in which sidewalks are protected from sunshine and rain	10	2,500	762
In an attractive but not weather-protected area during periods of inclement weather	5	1,250	381
In an unattractive environment (parking lot, garage, traffic-congested streets)	2	600	183

Sourse: Gruen, (1964)

Accessibility assessment methods

Conventionally, the transit service area is determined by GIS by creating a distance buffer around the transit route or the stops along that route (Ayvalik and Khisty, 2002; Murray, 2001). Although it is a popular method to estimate service area or accessibility, there are strong criticisms as well. Researchers criticize the assumptions of a uniform distribution

within the census polygon and population within the buffer of the transit route. Moreover, the buffer method tends to overestimate the population within the service area, since the actual walking distances within the buffer are greater than the Euclidean distances used to generate the buffer (Biba et al., 2010; Zhao et al., 2003).

To overcome the limitations of the buffer method, O'Neill et al. (1992) developed the network ratio method. By assuming evenly distributed population along streets, the pedestrian walking distances along streets were measured. The proportion of population in the transit service area was calculated as the ratio of the total length of streets within the preferred walking distance, to the total length of all streets.

Zhao et al. (2003) employed a regression method to forecast the transit population. Biba et al. (2010) employed a land parcel-based approach to estimate transit demand by developing a walking network based on 1320 feet walking distance. They showed that the other methods (buffer and network ratio method) overestimate the demand highly than the parcel-network method.

Transit accessibility is affected by many factors, including safe, pleasant, comfortable streets for walking to transit facilities; topography of the environment; parking facilities for cars and bicycles; handicap access etc. (Zhao et al., 2003). The elements that have to be considered while analyzing walking distance are the individual characteristics, station and area characteristics, bus route features, and temperature (El-Geneidy et al., 2010). Wibowo and Olszewski (2005) indicated that the physical features such as the street crossings, ascending steps and traffic conflicts along the walking route (for example: car parks) affect walking to and from the transit stops.

Accessibility has a great impact on ridership, while stop consolidation has some impacts on accessibility. An additional stop along a route means greater access and more acceptable walking/driving standards for a larger number of people. On the other hand, more stops and greater access slow transit travel speeds, thereby decreasing the area of service reachable given specific travel time constraints. The fewer the number of stops along a route, the faster the travel speeds and the farther one can travel in a fixed period of time (Murray 2001; Saka 2001; Furth and Rahbee 2000; Wirasinghe and Ghoneim

1981). Thus, accessibility has an inverse relationship with transit travel speed and reliability; accessibility has a positive relationship with travel time and ridership.

2.1.2.3 Other Factors

Passenger Activity

Ridership (boarding and alighting) of a transit stop represents its demand or passenger activity. A stop with consistent low activity can be a candidate for consolidation. In shared stops, ridership of a particular route can be very low, while ridership of other routes may be acceptable. In this case, stop consolidation can be considered only for the low ridership routes and not for the other routes with acceptable ridership.

Stopping pattern

Stopping pattern refers to the stopping position of the transit vehicle; on/off street. On street stopping does not need time to merge with the traffic, while off street stopping requires merging time. This effect can be prominent on congested roads without regulations of yielding to public transit vehicles. In these cases, travel time will increase due to the delay caused by merging.

Transfer Stop

Transfer stops should not be considered for stop consolidation. It may disrupt accessibility to other transit routes. In different stop consolidation studies and projects, the usual practice is to keep the transfer stops.

2.2 Components of Travel Time

Travel time can be perceived in two different perspectives; transit operator and user. According to transit operator's perspective, the travel time refers to the time needed for a transit vehicle to complete its route. The users perceive the transit travel time as the time taken to complete the trip by the transit vehicle. If a stop is consolidated, two groups of users will be affected. The first group is the through passengers, who will benefit from travel time savings. The second group, (original users of the consolidated stop) will have

to walk more (increase in walking time) to reach a stop. The components of travel time affected by consolidation are discussed below.

2.2.1 Transit Travel Time or Run Time

Transit travel time or run time comprises four main elements; acceleration and deceleration time, dwelling time at stops, delay time associated with traffic signals and unimpeded travel time involving cruise speed. Beside these, there are some exogenous factors such as weather, traffic, operator's attitude etc. (Saka, 2001). El-Geneidy and Surprenant-Legault (2010) and El-Geneidy et al. (2009) describe the variables that have significant effect on bus run time (Table 2.4). In the case of stop consolidation, transit travel time associated with the acceleration/deceleration and dwelling will be reduced (Oliviera et al., 2008; Chien and Qin, 2004; Saka, 2001). Stop consolidation will be no effect on travel time associated with the traffic signals or unimpeded travel.

Table 2.4 Factors Affecting Transit Travel Times

Variables	Description
Distance	Segment length
Intersections	Number of signalized intersections
Bus stops	Number of bus stops
Boarding	Number of passenger boarding
Alighting	Number of passenger alighting
Time	Time period
Driver	Driver experience
Period of service	How long the driver has been on service in the study period?
Departure delay	Observed departure time minus scheduled
Stop delay time	Time lost in stops based on bus configuration (low floor etc.)
Non-recurring events	Lift usage, bridge opening, etc.
Direction	Inbound or outbound service
Weather	Weather related conditions
Road	Road characteristics
Operating environment	Congestion

Source: El-Geneidy and Surprenant-Legault (2010) and El-Geneidy et al. (2009)

2.2.1.1 Impact on Dwelling Time

Dwelling time is defined as "*the time in seconds that a transit vehicle is stopped for the purpose of serving passengers. It includes the total passenger service time plus the time needed to open and close doors*" (HCM 1985) In Figure 2 1, the green and red portions together are considered as dwell time. The red portion is the time needed for door open and close while the green portion is the time taken for passengers boarding and alighting. Dwelling time can vary greatly among different transit stops, at different times of day, passenger loads, number of lift deployments for disabled passengers, and other factors such as the efficiency of the fare collection system Stop consolidation affect the dwelling time by saving the time needed for door opening and closing. As passengers will shift to other stops, there will be no change in the overall boarding and alighting time.

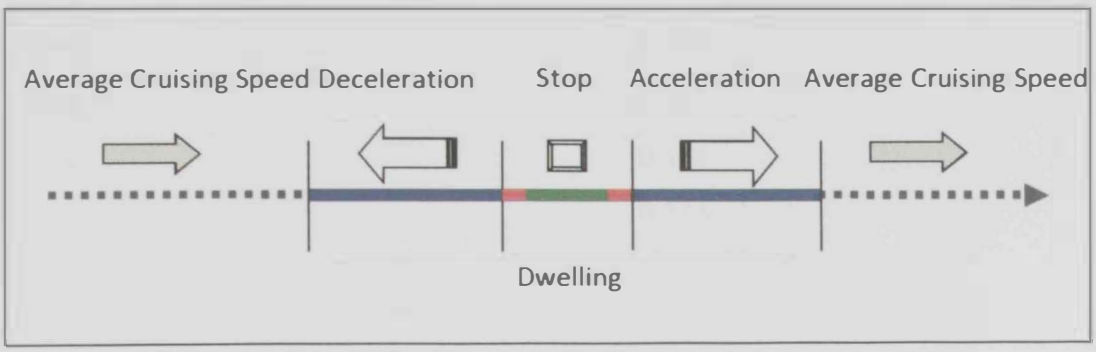


Figure 2.1: Travel Time Components Associated with Stops

Bertini and El-Geneidy (2004) developed regression equations to calculate the dwelling time They analyzed three scenarios; boarding plus alighting, only alighting and only boarding For boarding plus alighting model, the dwelling time is equal to 5 8 seconds plus 3.6 seconds per boarding plus 0.85 seconds per alighting. The 5.8 seconds is the time needed for opening and closing the door. Kraft and Bergen (1974) found that the passenger service time does not vary in AM and PM peaks. In midday, it requires more time than peak periods to serve passengers. Usually boarding times are more than the alighting times. There is no difference in the alighting times between the rear and front doors They found that the dwelling time is equal to 2 seconds plus 4.5 seconds for each boarding passenger in a cash and change fare structure. In exact fare structure, it equals 1.5 seconds plus 1.9 seconds for each boarding passenger. In Levinson (1983) study, the dwell time constant is found to be 5 seconds and 2.75 seconds for each boarding or alighting

Dueker et al. (2004) used extensive data of automatic vehicle location (AVL) and automatic passenger counter (APC) to develop their own dwelling time regression model. In addition to boarding and alighting, they incorporated several other factors like schedule maintenance, passenger friction, low floor bus, and time of day, which make their model more comprehensive. Moreover, they developed separate models (with/without lift operation) and only alighting and only boarding scenarios. The dwelling time model, without lift operation, is shown in Table 2.5. In their model, the constant (5.136 second) refers to the time needed for door open and close.

Table 2.5 Bus Dwell Time Model: Without Lift Operation

Name	Coefficient
Boarding	3.481
Boarding^2	-0.040
Alighting	1.701
Alighting^2	-0.031
On Time	-0.144
Low deck	-0.113
Passenger Friction	0.069
Mid-day period	1.364
Afternoon peak	0.924
Evening period	1.248
Late evening and early morning	0.069
Feeder route	0.145
Cross town route	-0.388
Constant	5.136
N	353,552
Adjusted R^2	0.3475

2.2.1.2 Acceleration-deceleration Time

Deceleration time is the time the transit vehicle takes after applying its break to halt in an approaching stop. Acceleration time is the time taken to regain cruising speed after leaving the stop. Simple formulas of dynamics can be used to predict these values. However, variations in driver skill, vehicle performance, traffic conditions, and roadside

conditions make it difficult to accurately predict this time (Kehoe, 2006). The deceleration/acceleration time is positively related to the number of stops.

Levinson (1983) developed an equation (equation 1) for acceleration and deceleration time per bus stop (t, in seconds) which depends on number of stops per mile (X).

$$t = 23.4 - 1.53X \quad (1)$$

Chien and Qin (2004) applied equation 2 to estimate acceleration and deceleration time (t) for stops. They used average speed (v), acceleration rate (a) and deceleration rate (b) to estimate this time.

$$t = \frac{v}{2a} + \frac{v}{2b} \quad (2)$$

Chien and Qin (2004) assumed the acceleration and deceleration rate to be the same (0.12 mile/second^2). Saka (2001) followed the AASHTO (1994) specification, 0.5 meter/second^2 for acceleration and 2.0 meter/second^2 for deceleration.

2.2.2 User's Travel Time

Users travel time can be divided into four parts: time to reach the stop from origin, waiting time, riding time and time to reach destination from stop. A graphical demonstration of the components of user's travel time is shown in Figure 2.2. Moving to and from stop usually involve walking (green portion in Figure 2.2) and thus often referred as walking time. Waiting time starts immediately after reaching the stop till riding (red portion in Figure 2.2). After that, riding time starts till the passenger alight at the destination stops (blue portion in Figure 2.2).

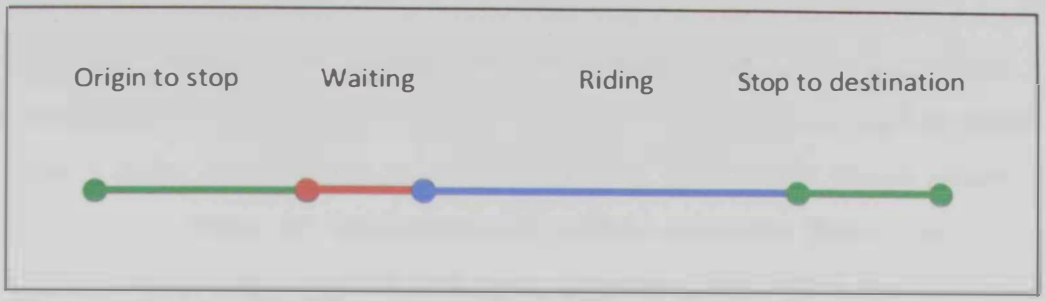


Figure 2.2: Graphical Representation of User's Travel Time Components

2.2.2.1 Impact on Through Users Travel Time

Through users refer to the on-board users passing through the consolidated stop. They are likely to gain (save) some riding time after stop consolidation. The amount of time gained in this process is the sum of acceleration, deceleration and door open-close times. As the affected users of the consolidated stop will use preceding or subsequent stops for dwelling, the time needed for loading and alighting (at the consolidated stop) will be distributed among these stops. As such, there will be no extra time saved for dwelling. Though there is one situation where some dwelling time is to be gained by through users alighting in the subsequent stop

2.2.2.2 Impact on Affected Users Travel Time

Affected users refer to the boarding and alighting passengers of the consolidated stop. Stop consolidation is likely to impact the walking time, waiting time and riding time of the affected users.

Impact on Walking Time

Stop consolidation increases the stop spacing so that the affected passengers have to walk longer distances, resulting in increased walking time. The walking time depends on the walking speed. A study conducted by Bohannon (1997) found that the mean comfortable gait (walk) speed ranges from 4.5 to 5.2 km/hr. TOD (2006) referred to standards of 2.5 to 3.1 miles/hr (4 to 5 km/hr). O'Sullivan and Morrall (1996) assumed 80 m/min (4.8 km/hr) walking speed, Li and Bartini (2008) used 4 feet/sec (4.4 km/hr).

Impact on Waiting Time

Furth and Muller (2006) indicated the considerable impact of the waiting time on the service reliability. Chien and Qin (2004) argued that if the headway is fixed, there will be

no effect on the waiting time of the users. This may be true if there is no reduction in ridership due to consolidation. If passengers were reduced due to the consolidation effect, some waiting time will be gained (reduced). A simple deterministic model is presented in MIT Open Course Ware (2010) to calculate waiting time of the transit passengers. If passenger arrival times are independent of vehicle departure times, vehicles depart deterministically at equal intervals and every passenger can board the first vehicle to arrive, the expected waiting time, $E(w)$ can be calculated from equation (3).

$$E(w) = E(h)/2 \quad (3)$$

Where, $E(h)$ = expected headway.

Impact on Riding Time

Riding time impact can be positive or negative. Users can save riding time if they choose subsequent stop for boarding and preceding stop for alighting. On the other hand, users will gain more riding time if they choose preceding stop to boarding and subsequent stop for alighting.

2.2.3 Value of Time

Hess et al. (2004) estimated the waiting time cost to be $8.5 per hour. In TDM encyclopedia, access cost (waiting + walking) is estimated as $8/hour and riding cost as $8/hour. Travel time value is generally half of the average wage rate. The value of time spent driving in congestion, walking to a transit stop, waiting for a bus, or traveling in unpleasant conditions such as in a crowded vehicle is two or three times the value of wage rate. Chien and Qin (2004) assumed operating cost of $50 per vehicle hour travelled, value of access time $20 per passenger per hour, and value of riding time of $12 per passenger per hour. Bertini and El-Geneidy (2004) used an operating cost of $60 per vehicle hour.

2.3 Distribution of Passenger

Distribution of passenger is critical to stop spacing or stop consolidation problems. A related term to this is the "catchment area" of the stop. The main methods to addressing

passenger distribution or catchment area involve simple buffering (Ayvalik and Khisty, 2002), detailed level GIS analysis (Biba et al., 2010; Furth et al., 2007; Challuri, 2006), and simple recti-linear distribution (Furth and Rahbee, 2000).

Furth and Rahbee (2000) introduced the concept of shed line; an imaginary line between two consecutive stops which determine each stop's market. Passengers were assumed to use the stops that minimize the weighted sum of their walking and riding times. The shed line formula can be written as:

$$r = \frac{C_r/C_w}{v_r/v_w} \quad (4)$$

Where, C_w = walking time, C_r = riding time, v_w = walking speed and v_r = riding speed

If the distance between adjacent stops is L, the shed line for a boarding passenger is located at a distance $(1-r)/2*L$ from the upstream stop (see Figure 2.3A). The shed line for alighting passengers is shifted identically towards the opposite direction or the downstream stop (see Figure 2.3B). A typical value of r for an urban application is 0.1; estimated using ratio C_r/C_w = 0.4, riding and walking speeds of 20 and 5 km/h, respectively.

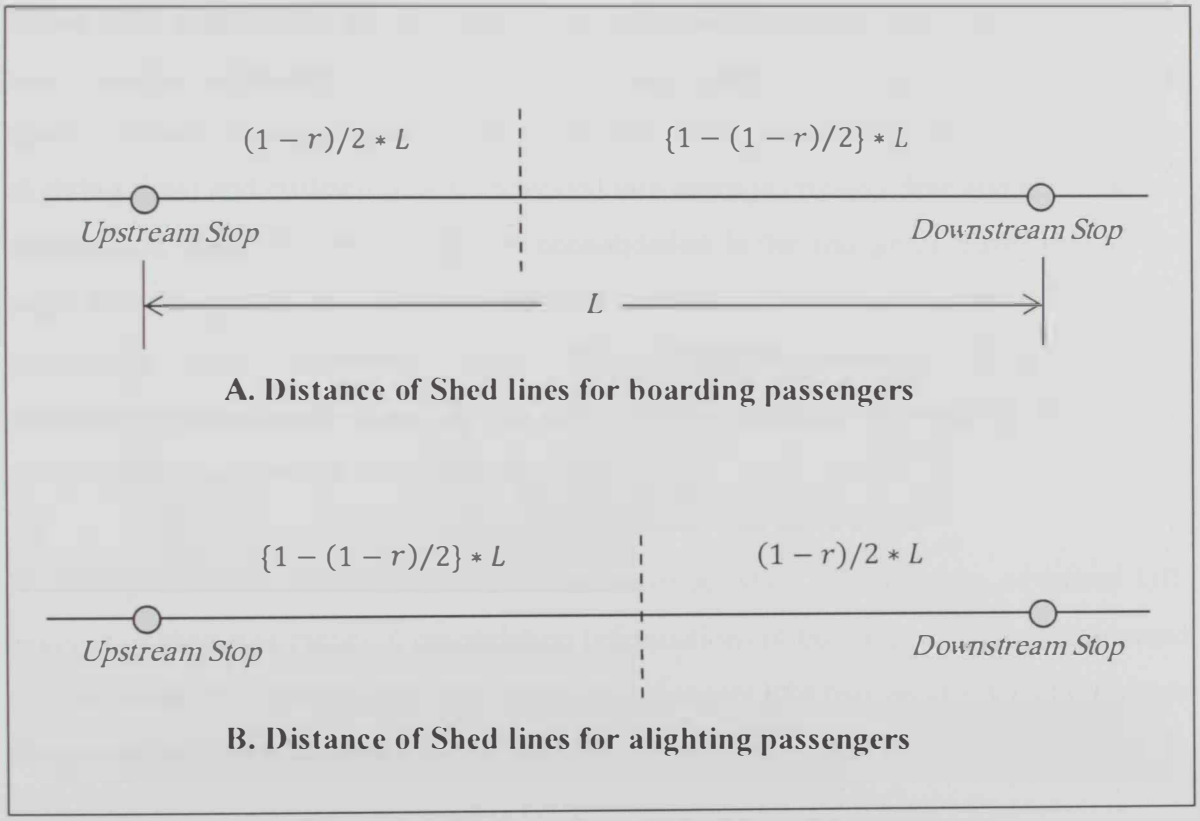


Figure 2.3: Elaboration of Shed Line Theory

2.4 Summary of the Literature Review

Stop consolidation can be done by merging two or more stops into one (existing or new), or eliminating existing stops. Stop consolidation decisions can be taken by evaluating optimum stop spacing and/or positioning a transit route, qualitative and/or quantitative assessment of particular stops and assessing the direct impacts and/or indirect impacts.

Stop consolidation can decrease trip time, thus reduce operating cost, and increase reliability. On the other hand, it can lead to passenger loss due to reduced accessibility. The factors considered in consolidation include the distance between stops, accessibility, passengers' activity, probable loss of passengers (change in transit demand) and transfer stops. Distance between stops is among the most important factor of consolidation. Many transport agencies have their own standards of distance between stops, which usually vary, depending on transit modes, population density etc. Accessibility is often assessed by average walkable distance or tolerance of walking, which varies with the physical environment of the walking path. In the literature, transit demand (after consolidation) is mostly assumed to be unchanged or very small.

Travel time components are different for the users and the transit operation. Users' travel time contains access-egress time, waiting time and riding time, while operating time (run time) contains dwelling time (subdivided into door open-close time and boarding-alighting time) and cruising time (subdivided into average cruising time and acceleration-deceleration time). The main effect of consolidation is the change of travel time of the users and the operation. Stop consolidation decreases the riding time of the on-board passengers and operating time by eliminating/reducing dwelling and acceleration/deceleration times. At the same time, it increases the walking time of the passengers who supposed to use the stop.

Each stop market (spatial distribution) can be established by buffering, advanced GIS analysis or shed-line theory. Consolidation (elimination) of bus stops changes the demand market around the consolidated stop. It splits passengers into two groups. One group uses the preceding stop and another group chooses the consecutive stop.

This study identifies six major factors that can influence consolidation decisions. The study also spotted that, no researchers considered all these factors in a single model. Therefore, the study attempted to formulate a model comprising all of these factors. It computes the direct effect of consolidation (travel time savings) in each stop and uses this in a combinatorial procedure to determine the group of stops that maximizes travel time savings. The consolidation stops are maximized by using iterative procedure. Researchers usually followed dynamic or linear programming methods to optimize the results. The use of a combinatorial and iterative process is somewhat different than other studies. The study uses an experimental design method (to assess the impacts of the factors), instead of usual sensitivity analysis used by other researchers.

Chapter 3

MODEL DEVELOPMENT

Travel time of a transit vehicle is a function of average cruising speed, acceleration-deceleration time and dwelling time at bus stops. On the other hand, users travel time is a function of the walking time, waiting time and in-vehicle travel time. A change in the number of stops changes the travel time for both transit vehicle and users. For instance, if one stop is consolidated, it will reduce (gain) the travel time for the transit vehicle as well as the passengers on-board. On the other hand, some passengers, who used to use the consolidated stop, may have to walk more, which will result in an increase (loss) of their travel time. The proposed model computes the travel time savings of the users by consolidating each candidate stop of a given route. Finally, it suggests which stops to be consolidated, and how much users' travel time can be saved. It also computes the gain of transit vehicle's operating time and operating cost. Details of this model are described in this chapter.

3.1 Assumptions of the Model

The model has certain assumptions. These are described below.

- The transit route is assumed to be a frequency-based route. It has a certain hourly frequency and headway.
- It is assumed that the transit vehicles reach the stops, dwell and immediately start the trip to the next stop.
- Vehicles reach a complete stop from a specific cruising speed by a fixed deceleration rate, and start from a stop by a fixed acceleration rate to reach a certain cruising speed. The acceleration/deceleration rate varies for different types of transit vehicles (bus, light-rail, train, tram etc.)
- Vehicles may cruise in different speeds between two stops; for simplification average cruising speed (space mean speed) is considered.

- Users walk to access and to egress from the stop.
- The passengers are assumed to be distributed evenly throughout the transit line.
- The passengers are assumed to use the stops that minimize a weighted sum of their walking and riding times (see details in section 2.3).
- The users of the consolidated stops split into two groups to use the two adjacent (preceding and subsequent) stops.
- Waiting time of the passengers starts after reaching the stop to before boarding.
- Door open and close time refers to the time needed to open the transit door after reaching a complete stop, to begin boarding/alighting operation, plus the time needed to close the door after finishing the boarding/alighting operation.

3.2 Structure of the Model

The model program is developed as a Visual Basic Application in Microsoft Excel. The structure of the model is shown in Figure 3.1. The model has seven main modules: data input, creating data table, determining eligible stops, calculations, decision module for consolidation, and finally the data update and output. Data is updated only if a stop is decided for consolidation. In this case, the model updates the profile of the route (data table), and then continues to the following modules (determining eligible stops, calculations and decision module for consolidation). This loop (iteration) continues till there is no more stops to be consolidated. Finally, different outputs are generated. The main modules are described in the following sections.

3.2.1 Data Input

In this module, all the necessary data are provided in the model. The details of the input variables are given in the Table 3.1. The model has sixteen input variables. The first six are stop/link variables. The seventh variable denoted by 'per' can vary for individual stops, though in the current model it is considered as a variable of the analyzed route. This variable can be obtained through user survey. The variable denoted by 'Max_dist' can also be obtained through user survey. The variable denoted by 'Frequency' is a route attribute, usually fixed for different peak hours on a particular route. Variables denoted by 'ac', 'dc' and 'door' vary with the transit types. In this model, typical values for bus transits are assumed. The 'Disutility' values depends on the level of urbanization. Here, a

typical urban setting is considerd. Walking speed 'vw' may vary based on the climatic conditions. The remaining two variables 'B_Time_per_Pax' and 'A_Time_per_Pax' depend on the transit type, lift operations, and rear-door operations, and also can be obtained through survey/study.

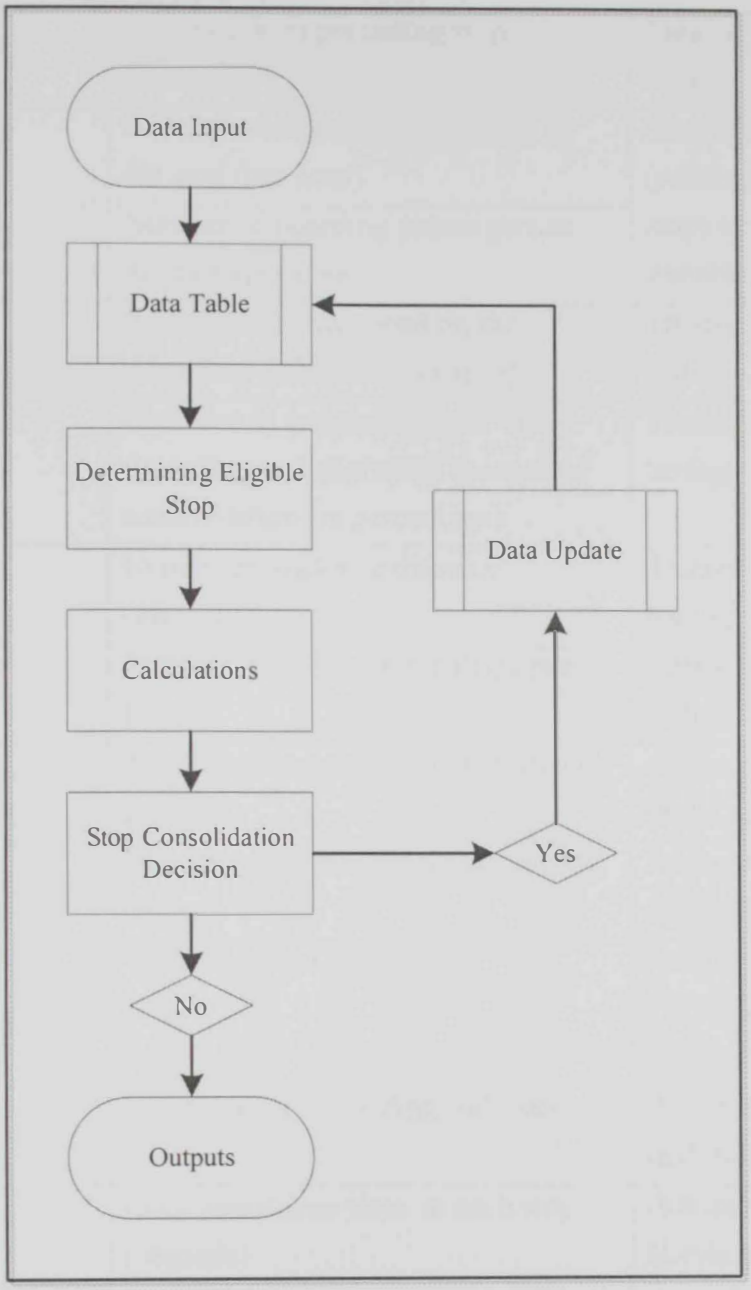


Figure 3.1: Structure of the Model and Program Modules

This model is designed to choose stops for consolidation on a particular route. As such, all the information are route-based. For example, a stop may be used along several routes, but the boarding/alighting information of the chosen route should be picked correctly (route-based).

Table 3.1 Description of the Input Variables

No.	Variable Name*	Variable Description	Comments
1	Stop_no	Stop number /name for identification	
2	Transfer	Whether the stop is a transfer stop or not	1 for true and 0 for false
3	Dp	Distance from preceding stop (meters)	Treated as a variable for testing
4	A	Number of alighting passengers at the stop (per hour)	Sum of A and B (passenger activity in stop) treated as a variable for testing
5	B	Number of boarding passengers at the stop (per hour)	
6	vP	Average cruising speed on the preceding link section (km/hr)	Treated as a variable for testing
7	per	Decrease in passengers' activity (boarding and alighting) because of consolidation (in percentage)	Treated as a variable for testing
8	Max_dist	Maximum walkable distance (meters)	Treated as a variable for testing
9	Frequency	Frequency of the service (trips per hour)	Treated as a variable for testing
10	ac	Acceleration rate (meters per second square)	Assumed 0.5 m/s^2 (Saka, 2001)
11	dc	Deceleration rate (meters per second square)	Assumed 2 m/s^2 (Saka, 2001)
12	vw	Walking speed (km/hr)	Assumed 5 km/hr (TOD' 2006; Furth and Rahbee, 2000)
13	Disutility	Disutility ratio of riding and walking	Assumed 0.4 (Furth and Rahbee, 2000)
14	Door	Door open/close time at each stop (seconds)	Assumed 5 seconds (Levinson, 1983)
15	B_Time_per_Pax	Boarding time per passenger (seconds)	Assumed 3.5 seconds (adopted from Bertini and El-Geneidy, 2004)
16	A_Time_per_pax	Alighting time per passenger (seconds)	Assumed 1 second (adopted from Bertini and El-Geneidy, 2004)

*variable name used in the Excel VBA codes

3.2.2 Preparing Data Table

Data gathered from the previous module is then organized in this one. To do so, a data table (an array) is developed, which contains all the necessary information of stops and links. A two-dimension array named "data_table" is coded, where the rows record stops and the columns record the attributes of stops. Table 3.2 describes the information (attributes) recorded in different columns of the "data_table". Some data are directly taken from the data_table (columns 1 to 10), while others are calculated in the calculation module and then recorded in the data_table (columns 11 to 20).

Table 3.2 Attributes of the data_table

Column Number	Description
1	Original stop name/number
2	Transfer stop
3	Distance from preceding stop
4	Distance to subsequent stop
5	Number of alighting passengers
6	Number of alighting passengers at subsequent stop
7	Number of boarding passengers
8	On-board passengers
9	Cruising speed along the preceding link section
10	Cruising speed along the subsequent link section
11	Current stop number
12	Boarding passengers at the preceding stop after consolidation
13	Boarding passengers at the subsequent stop after consolidation
14	Alighting passengers at the preceding stop after consolidation
15	Alighting passengers at the subsequent stop after consolidation
16	Travel time savings
17	Cruising time on preceding link (seconds)
18	Cruising time on subsequent link (seconds)
19	Average speed on preceding link (meters/second)
20	Average speed on subsequent link (meters/second)

3.2.3 Determining Eligible Stop

In stop consolidation projects, certain factors are considered for consolidation (see section 2.1.2). These are stop spacing, accessibility, stopping pattern, transfer stops, etc. Stop spacing can be considered as a measure of accessibility. In this model, we consider maximum walkable distance and transfer stops as the deciding factors of consolidation. The maximum walkable distance is a good measure of accessibility. As a result, we do not account for stop spacing. Transfer stops are important to keep, as these provide accessibility to other routes. We do not consider the stopping pattern, to avoid eliminating stops without proper investigation. Stops are chosen as "eligible for consolidation" if the following conditions are fulfilled:

1. The stop is not the origin stop of the route
2. The stop is not the destination stop of the route
3. The stop is not a transfer stop
4. The shed-lines of the stop are located within the maximum walkable distance

3.2.4 Calculations

There are three major calculations involved in this model; "users initial travel time", "users travel time savings" and "operating time savings". These three calculations are described below.

3.2.4.1 Users Initial Travel Time

The initial time of travel of all the users is calculated in five steps. The first step calculates the walking time needed for the users (boarding and alighting) at each stop. The second step calculates the waiting time for the boarding passengers. The third step calculates the waiting time of the users during the door open and close. The forth step calculates the time spent by the users in boarding-alighting operation. The last part calculates the time spent by the on-board users in the cruising operation on links. The first four steps are calculated using the transit stop information, and the last one is calculated from the stop and subsequent link information. If there are n stops along a route, the users initial travel times are calculated using the following equations (equation 3.1 to 3.6).

$$users\ initial\ travel\ time = \sum_n (walk\_time + wait\_time + door\_time + B\_A\_time + cruising\_time) \quad (3.1)$$

$$walk\_time = (walking\ distance\ of\ boarding\ passengers\ before\ consolidation + walking\ distance\ of\ alighting\ passengers\ before\ consolidation) \div walking\ speed \quad (3.2)$$

$$wait\_time = \frac{1}{2} \times number\ of\ boarding\ passengers \times headway \quad (3.3)$$

$$door_{time} = door\ open\&close\ time \times (onboard\ passengers + number\ of\ alighting\ passengers) \quad (3.4)$$

$$B\_A\_time = (boarding\ time\ per\ passenger \times number\ of\ boarding\ passengers) \times onboard\ passengers + (alighting\ time\ per\ passenger \times number\ of\ alighting\ passengers) \times onboard\ passengers + (alighting\ time\ per\ passenger \times number\ of\ alighting\ passengers) \quad (3.5)$$

$$cruising\_time = cruising\ time\ for\ subsequent\ link \times onboard\ passengers \quad (3.6)$$

The calculation of the cruising time on the subsequent link is described in Annexure 1. This data is recorded in column 18 of the data_table described in Table 3.2.

3.2.4.2 Travel Time Savings

The idea of the model is to calculate the potential travel time savings of the users by hypothetically consolidating stops. The travel time savings has two major sub-components; travel time savings of through users (see details in section 2.2.2.1) and travel time change of the affected users at the transit stops (see details in section 2.2.2.2).

3.2.4.2.1 Through Users Travel Time Savings

As discussed in section 2.2.2.1, the travel time gained by the through users (T_{TU}) can be formulated as follows (equation 3.7).

$$T_{TU} = t_{ad} + t_d + t_b \quad (3.7)$$

Where, t_{ad} = acceleration/deceleration time at stop n, t_d = door open/close time, and t_b = (boarding time of affected passengers at stop $n+1$) × (number of alighting passengers at stop $n+1$)

The calculation of t_b is graphically illustrated in Figure 3.2. Stop n is decided to be consolidated, and currently it has an activity of 5 alighting (green) and 4 boarding (red) passengers. The preceding stop, n-1, has 2 boarding (pink) and 3 alighting (light green) activities. The subsequent stop, $n+1$, has 5 boarding (pink) and 2 alighting (blue-marked) activities. Through passengers are shown in blue color. If stop n is consolidated, the passengers of this n stop will have to use either stop n-1 or stop $n+1$. The situation after consolidation is presented in Figure 3.2 (B). The marked through passengers, alighting at stop $n+1$, can gain the boarding time of the affected passengers (2 passengers in red) shifted from stop n to $n+1$. Thus, a time savings in riding can be gained by the through passenger(s) alighting at the subsequent stop of consolidation. The amount of saving is the boarding time taken by the affected boarding passengers at the subsequent stop of consolidation.

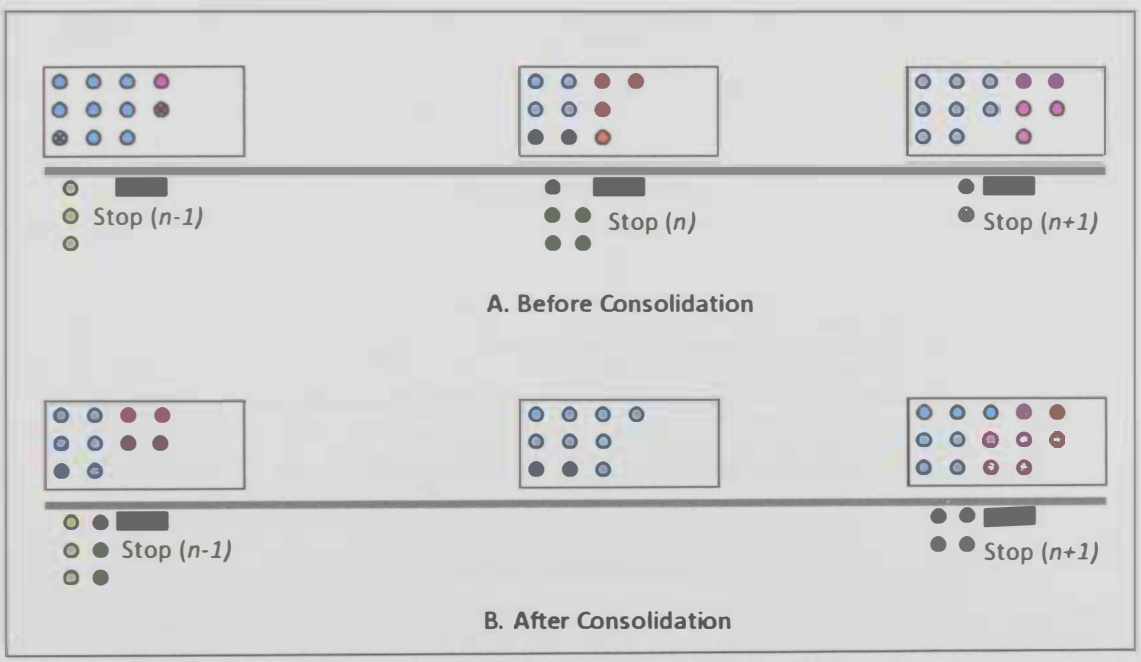


Figure 3.2: Graphical Representation of Travel Time Savings

3.2.4.2.2 Affected Users Travel Time Change

Affected users travel time change (T_{AU}) can be calculated using the following equation (equation 3.8).

$$T_{AU} = t_{wk} + t_{wt} + t_r \tag{3.8}$$

Where, t_{wk} = Change in walking time for affected passengers, t_{wt} = Change in waiting time for affected passengers, and t_r = Change in riding time for affected passengers

Calculation of Change in Walking Time

The impact of stop consolidation on walking distance is shown in Figure 3.3. The first part of this figure shows the walking distance of the passengers before consolidation. The second part shows the walking distance after the consolidation. The walking distance increases after the consolidation. Here, the walking distance is assumed to be parallel to the road. The change in walking time can be calculated from equation 3.9 and 3.10.

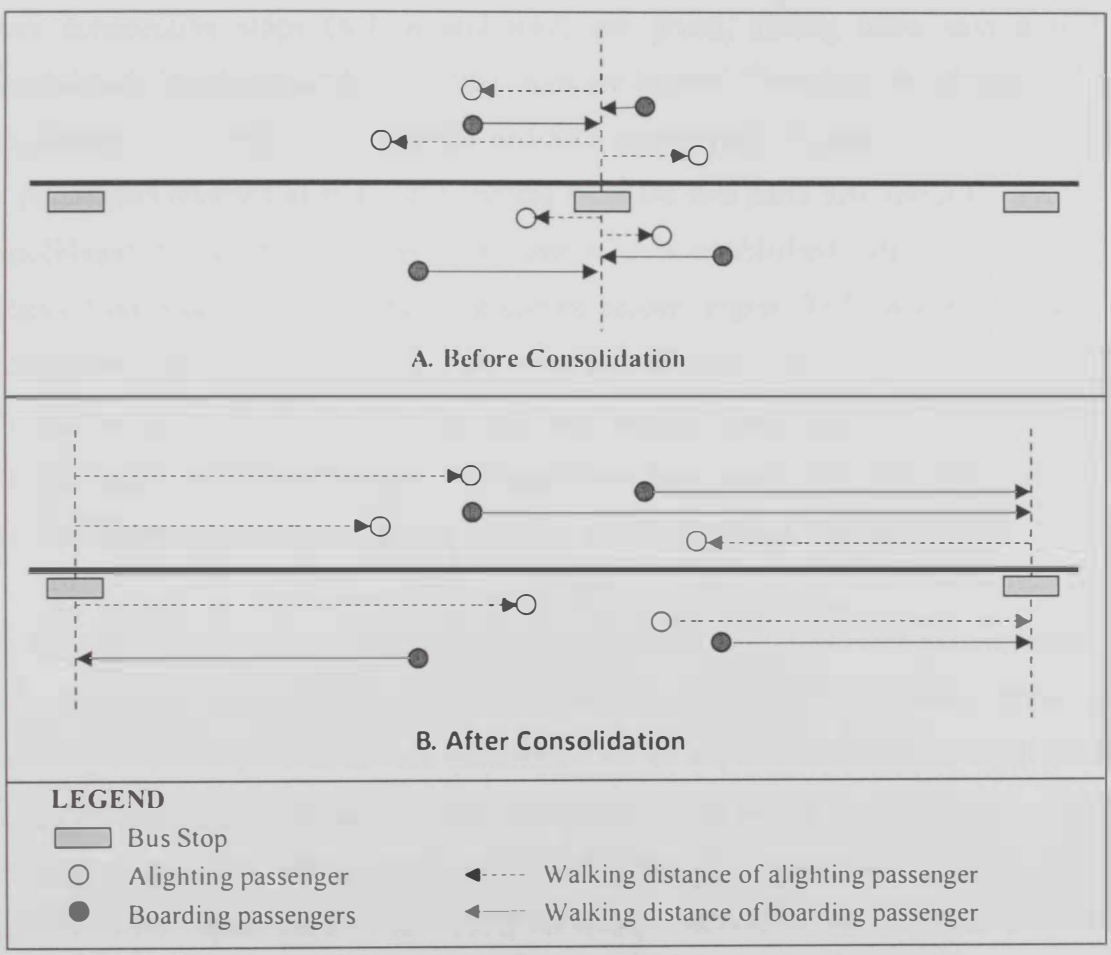


Figure 3.3: Impact on Affected Users Walking Distance

$$t_{wk} = d_{wk}/v_{wk} \quad (3.9)$$

$$d_{wk} = d^a_{wk} - d^b_{wk} \quad (3.10)$$

Where, d_{wk} = total change is walking distance of affected users, d^a_{wk} = distance walked by the users after consolidation, d^b_{wk} = distance walked by the users before consolidation, and v_w = Average walking speed.

Calculation of Change in Walking Distance

To calculate the distance walked, it is necessary to have two important data: the total number of users (boarding and alighting) and the origin/destination of their walk. Boarding and alighting data at stops are normally kept by the service providers, and it is usually available. The origin or destination of walkers is not easy to get. The shed-line theory (discussed in section 2.3) is used to distribute the passengers after consolidation. Figure 3.4 explain the use of shed-line theory with an example of boarding passengers.

Three consecutive stops (*n-1*, *n* and *n+1*) are given, among them stop *n* will be consolidated. The distances between the stops are known. Therefore, the distance of shed lines among *n-1*, *n* and *n*, *n+1* are *SB1* and *SB2*, respectively (Figure 3.4A). It means that the passengers boarded at stop *n* are coming from the two parts *SB1* and *SB2*. If stop *n* is consolidated, the shed line between *n-1* and *n+1* is established, which is located *SBC* distance from stop *n+1*. This shed line can be before (Figure 3.4B, where *ds* < *SBC*) or after (Figure 3.4C, where *ds* > *SBC*) the consolidated stop *n*. In the former case, it divides *SB1*, and in the latter case, it divides *SB2* into two new parts *SB3* and *SB4*. That means that boarding passengers of stop *n* will come from three parts; *SB1-SB3-SB4* or *SB2-SB3-SB4*. For alighting passengers, it will be same but the distances will be changed.

For the distribution of the passengers, this model has two important assumptions. The first assumption implies that the passengers will be distributed among these parts according to the proportion of their distances. For example, (see Figure 3.4D) if the total number of boarding passengers (before consolidation) in stop *n* is *B*, then the passengers split among parts *SB1*, *SB3* and *SB4* are *Bb1*, *Bb3* and *Bb4*, respectively. The splits can be calculated from equations 3.11 to 3.13. If the number of boarding passengers is decreased

by certain percentage (*per*) after the consolidation of stop *n* (see Figure 3.4E), the number of boarding passengers becomes $B \times (1 - per)$. The passenger splits after consolidation (*Ba1*, *Ba3* and *Ba4*) of the three parts (*SB1*, *SB3* and *SB4*) will follow the same principle.

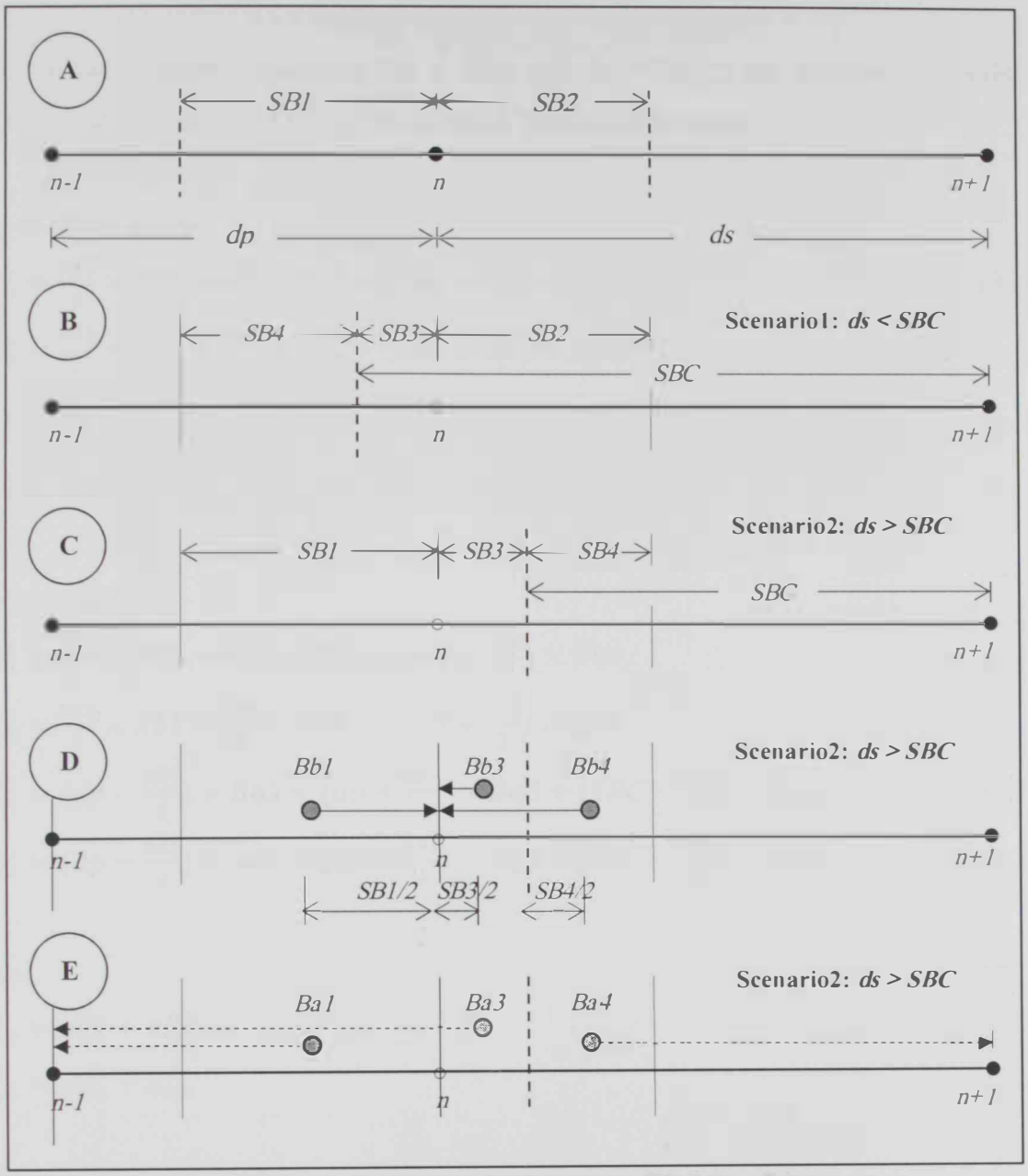


Figure 3.4: Calculation of Change in Walking Distance

$$Bb1 = B \times SB1/(SB1 + SB2) \quad (3.11)$$

$$Bb3 = B \times SB3/(SB1 + SB2) \quad (3.12)$$

$$Bb4 = B \times SB4/(SB1 + SB2) \quad (3.13)$$

The second assumption implies that passengers of each part will be accumulated or generated to/from the mid-point of these parts. This is illustrated in Figure 3.4D. Boarding passengers (before consolidation of stop n) of part $SB1$ ($Bb1$) is generated from mid-point of this part, which is $SB1/2$ distance away from stop n.

For the two different scenarios ($ds < SBC$ and $ds > SBC$), the equations of walking distance calculation will be slightly different. These will be as follows:

For scenario 1

$$d_{wk}^{Bb} = \frac{SB2}{2} \times Bb2 + \frac{SB3}{2} \times Bb3 + (SB3 + \frac{SB4}{2}) \times Bb4 \quad (3.14)$$

$$d_{wk}^{Ab} = \frac{SA2}{2} \times Ab2 + \frac{SA3}{2} \times Ab3 + (SA3 + \frac{SA4}{2}) \times Ab4 \quad (3.15)$$

$$d_{wk}^{Ba} = (ds - \frac{SB2}{2}) \times Ba2 + (ds + \frac{SB3}{2}) \times Ba3 + (dp - SB3 - \frac{SB4}{2}) \times Ba4 \quad (3.16)$$

$$d_{wk}^{Aa} = (ds - \frac{SA2}{2}) \times Aa2 + (ds + \frac{SA3}{2}) \times Ba3 + (dp - SA3 - \frac{SA4}{2}) \times Aa4 \quad (3.17)$$

For scenario 2

$$d_{wk}^{Bb} = \frac{SB1}{2} \times Bb1 + \frac{SB3}{2} \times Bb3 + (SB3 + \frac{SB4}{2}) \times Bb4 \quad (3.18)$$

$$d_{wk}^{Ab} = \frac{SA1}{2} \times Ab1 + \frac{SA3}{2} \times Ab3 + (SA3 + \frac{SA4}{2}) \times Ab4 \quad (3.19)$$

$$d_{wk}^{Ba} = (dp - \frac{SB1}{2}) \times Ba1 + (dp + \frac{SB3}{2}) \times Ba3 + (SBC - \frac{SB4}{2}) \times Ba4 \quad (3.20)$$

$$d_{wk}^{Aa} = (dp - \frac{SA1}{2}) \times Aa1 + (dp + \frac{SA3}{2}) \times Ba3 + (SAC - \frac{SA4}{2}) \times Aa4 \quad (3.21)$$

Now,

$$d_{wk}^{a} = d_{wk}^{Ba} + d_{wk}^{Aa} \quad (3.22)$$

$$d_{wk}^{b} = d_{wk}^{Bb} + d_{wk}^{Ab} \quad (3.23)$$

Where,

d_{wk}^{Bb}= Walking distance of boarding passengers before consolidation, d_{wk}^{Ab}= Walking distance of alighting passengers before consolidation, d_{wk}^{Ba}= Walking distance of boarding passengers after consolidation, d_{wk}^{Aa}= Walking distance of alighting passengers after consolidation. $SB1$, $SB2$, $SB3$ and $SB4$ are shed line partitions for boarding passengers, $SA1$, $SA2$, $SA3$ and $SA4$ are shed line partitions for alighting passengers. $Bb1$, $Bb2$, $Bb3$ and $Bb4$ are number of boarding passengers in different parts before consolidation, $Ba1$,

Ba2, *Ba3* and *Ba4* are number of boarding passengers in different parts after consolidation. *Ab1*, *Ab2*, *Ab3* and *Ab4* are number of alighting passengers in different parts before consolidation, *Aa1*, *Aa2*, *Aa3* and *Aa4* are number of alighting passengers in different parts after consolidation. *dp* = distance from preceding stop, *ds* = distance from subsequent stop. *SBC* = Shed line for boarding passengers from subsequent stop to preceding stop after consolidation, *SAC* = Shed line for alighting passengers from subsequent stop to preceding stop after consolidation, $d^a_{wk} = d^b_{wk}$.

Calculation of Waiting Time change

Change in waiting time is calculated from the following equation (equation 3.24).

$$t_{wt} = \frac{1}{2} \times (BP \times per \times headway) \quad (3.24)$$

Where, *BP* = number of boarding passengers at the consolidated stop, *per* = decrease in passengers activity due to consolidation (in percentage)

Calculation of Riding Time

The riding time impact can be positive or negative. Users can gain riding time if they choose the subsequent stop for boarding and the preceding stop for alighting. On the other hand, users will lose riding time if they choose the preceding stop to boarding and the subsequent stop for alighting.

In Figure 3.5, the impact of stop consolidation on the riding time is presented. It shows the riding time needed for each segment. Here, stop *n* is the stop to be consolidated. Stop *n-1* is the preceding stop, stop *n+1* is the subsequent stop, t_1 and t_2 are the riding time needed to travel segment 1 (distance d_1) and segment 2 (distance d_2), respectively. v_1 and v_2 are the cruising speeds on segments 1 and 2, respectively. The change in the riding time (t_r) can be divided into two portions; change in riding time for alighting passengers (t_r^a) and change in riding time for boarding passengers (t_r^b) (equation 3.25). According to Figure 3.5, t_r^a and t_r^b can be written by equations 3.26 and 3.27.

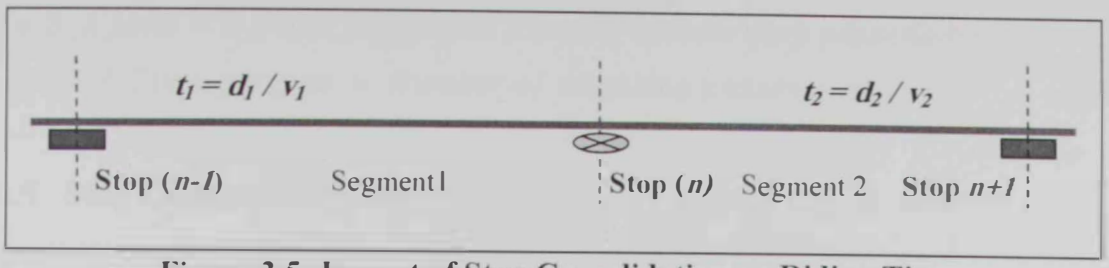


Figure 3.5: Impact of Stop Consolidation on Riding Time

$$t_r = t_r^a + t_r^b \tag{3.25}$$

$$t_r^a = \left\{\left(A_{n-1}\frac{d_1}{v_1}\right) - \left(A_{n+1}\frac{d_2}{v_2}\right)\right\} \tag{3.26}$$

$$t_r^b = \left\{\left(B_{n+1}\frac{d_2}{v_2}\right) - \left(B_{n-1}\frac{d_1}{v_1}\right)\right\} \tag{3.27}$$

Where, A_{n-1} and A_{n+1} are the number of alighting passengers at stop *n-1* and *n+1*, respectively. B_{n-1} and B_{n+1} are the number of boarding passengers at stop *n-1* and *n+1*, respectively.

3.2.4.3 Calculating Operating Time Savings

Operating time savings are calculated from the initial and final operating times shown in equation 3.28. Operating times (both initial and final) are calculated from the cruising time on each subsequent link, door open close time at each stop and boarding-alighting time at each stop. If there are *n* stops, the operating time can be calculated from equation 3.29.

$$Operating\ time\ savings = \frac{(Initial\ operating\ time - Final\ operating\ time)}{Initial\ operating\ time} \times 100 \tag{3.28}$$

$$Operating\ time = \sum_n (Trip\_cruising\_time + Trip\_door\_time + Trip\_B\_A\_time) \tag{3.29}$$

Where, *Trip_cruising_time* = the time needed for cruising on the subsequent link (data is kept in column 18 of data_table (see Annexure I for the calculations); *Trip_door_time* = time needed to open and close door at each stop (see Table 3.1); Trip_B_A_time = time needed to board and alight passengers at each stop, calculated from equation 3.30.

$$Trip\_B\_A\_time = B\_Time\_per\_pax \times Number\ of\ boarding\ passengers + A\_Time\_per\_pax \times Number\ of\ alighting\ passengers \quad (3.30)$$

3.2.5 Stop Consolidation Decision

In the previous part, the travel time savings of eligible stops are calculated with the assumption that the users will split to the two adjacent (preceding and subsequent) stops after consolidation. As such, the adjacent stops should be kept, though they may yield positive travel time savings. If a series of stops (consecutive stops) provide positive travel time savings, the combination of stops (to be consolidated) are analyzed. The best combination according to the travel time savings is chosen for consolidation. This is explained using some hypothetical data provided in Table 3.3.

Case 1: This is a simple situation. Stop 2 provides positive yield and adjacent stops (stops 1 and 3) cannot be consolidated. Thus, Stop 2 can be consolidated.

Case 2: In this situation, two consecutive stops are considered for consolidation. As Stop 4 yield negative value (travel time loss), it cannot be considered for consolidation. Stop 5 yield positive value (travel time savings), which suggests a consolidation.

Case 3: In this situation, two consecutive stops are considered for consolidation. As both the stops yield positive value, both can be considered for consolidation. There can be two combinations in this situation. Among these, Stop 8 is chosen for consolidation because of yield.

Case 4: In this situation, five consecutive stops are considered for consolidation. As all the stops yield positive values, all stops can be considered for consolidation. There can be twelve probable combinations in this situation, 5 of them consist of only one stop, 6 combinations consist of 2 stops, and 1 combination have 3 stops. Among these 12 combinations, combination 9 produces the highest yield. In this case, Stops 12 and 14 (members of combination 9) are chosen for consolidation. One thing to note here is that combination 12, although a combination of three stops is not picked, as it produces lower yield than combination 9.

Table 3.3 Hypothetical Data Table for Explaining Stop Consolidation Decision

Original Stop Number	Current Stop Number	Travel Time Savings	Probable Combinations (stop numbers) and Yield (total travel time savings)	Comments	Decision (√=chosen X = decline)
1	1	N/A	N/A	Not eligible	X
2	2	+50	1) 2 = +50	Case 1	√
3	3	N/A	N/A	Not eligible	X
4	4	-22	1) 5 = +20	Case 2	X
5	5	+20			√
6	6	N/A	N/A	Not eligible	X
7	7	N/A	N/A	Not eligible	X
8	8	+64	1) 8 = +64	Case 3	√
9	9	+53	2) 9 = +53		X
10	10	N/A	N/A	Not eligible	X
11	11	+34	1) 11 = +34	Case 4	X
12	12	+84	2) 12 = +84		√
13	13	+29	3) 13 = +29		X
14	14	+93	4) 14 = +93		√
15	15	+42	5) 15 = +42 6) 11+13 = +63 7) 11+14 = +127 8) 11+15 = +76 9) 12+14 = +177 10) 12+15 = +126 11) 13+15 = +71 12) 11+13+15 = +105		X
16	16	N/A	N/A	Not eligible	X

3.2.6 Data Update

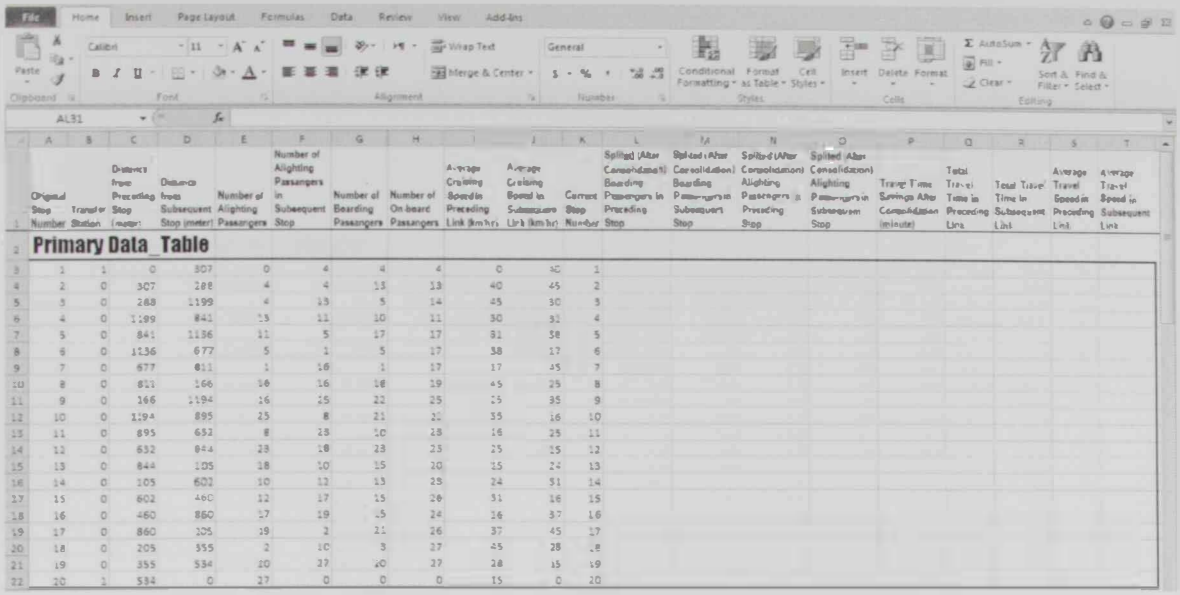
If any stop is decided for consolidation (by the Stop Consolidation Decision module), a new data profile of the route is created to re-check whether further consolidation can be done or not (carry on another iteration). If no more consolidation is done, the program

goes to the "Output" module. For example, if we consider Table 3.3, from the profile of 16 stops, 5 stops are decided to be consolidated. The remaining 11 stops (stops 1, 3, 4, 6, 7, 9, 10, 11, 13, 15 and 16) will be considered as the new route profile (note that the current stop number will be changed), and subsequently it will be analyzed from the updated data table.

The data update is necessary because the information of the preceding and subsequent stops will be changed after consolidation. This will bring a change in the "data_table" attributes (Table 3.2). In the first step, the distance between the stops (column 3 and 4) are adjusted. The number of alighting and boarding passengers (column 5, 6 and 7) are also adjusted from the information of column 12, 13, 14 and 15. The number of on-board passengers (column 8) is re-calculated. Average speeds on links (column 19 and 20) are reestimated after calculating the new cruising times (column 17 and 18). Finally, the cruising speeds are calculated (column 9 and 10). Calculations of cruising time, average speed and cruising speed are elaborated in Annexure 1.

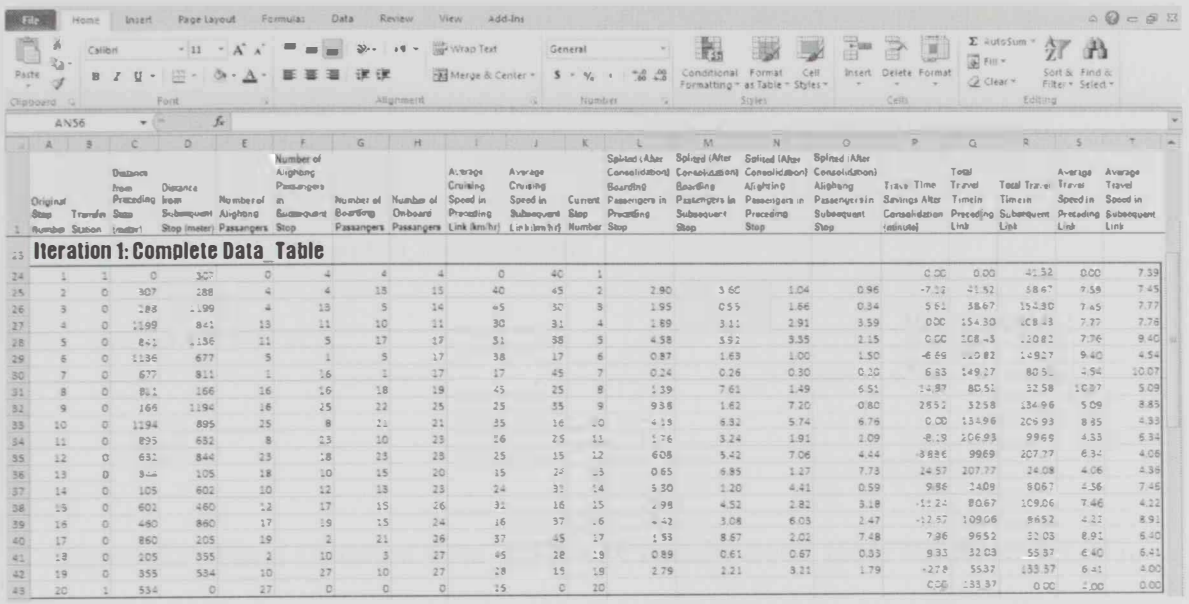
3.2.7 Output

In this module, detailed results are illustrated. This includes the data_table(s), their changes (updates) at each iteration and a summary sheet. Figure 3.6 to Figure 3.10 shows the output data of a hypothetical dataset. Figure 3.6 shows the primary data_table of the 1st iteration, which mainly contains the primary input data. Figure 3.7 shows the complete data_table of the 1st iteration, where the empty cells of Figure 3.6 are filled after calculations. Figure 3.8 shows the updated data_table after the consolidation decision took place. Figure 3.9 shows the final updated data_table of 1st iteration, which is used afterwards as the primary data_table for 2nd iteration. Figure 3.10 shows the summary of the program output. The summary sheet includes the name (or number) of the stops chosen for consolidation, percentage of consolidated stops, travel time savings at each stop, total travel time savings, initial travel time of the users, percentage of travel time savings, initial operating time and percentage of operating time savings. Moreover, it provides other information like parameters of the route and assumptions of the model.



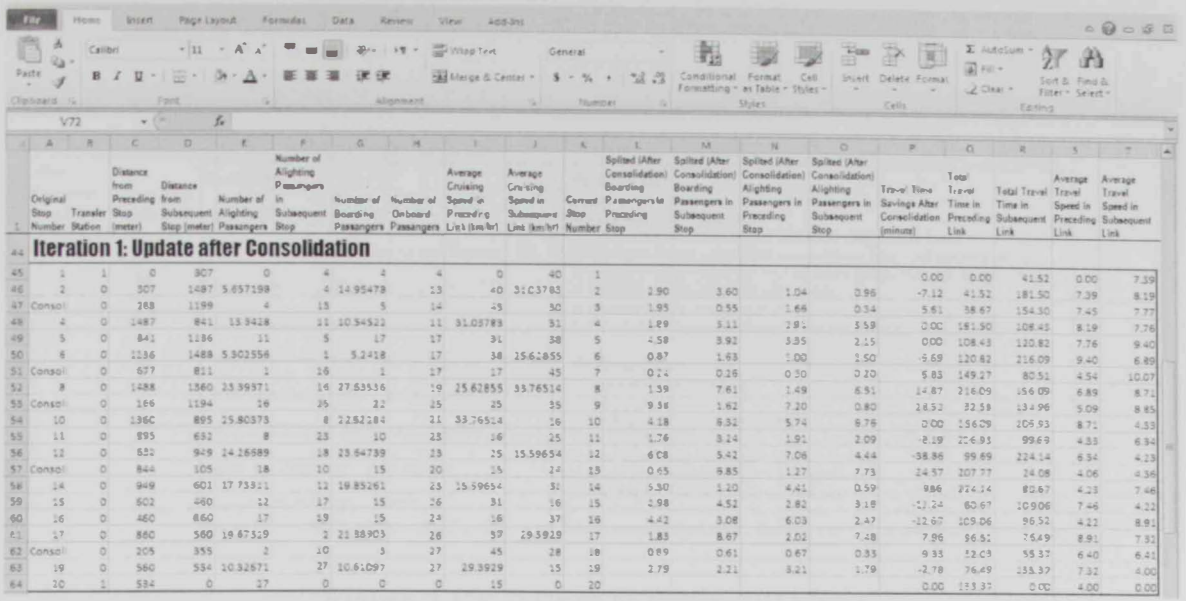
Original Stop Number	Transfer Station	Distance from Preceding Stop (meter)	Distance from Subsequent Stop (meter)	Number of Alighting Passengers	Number of Alighting Passengers in Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Average Cruising Speed in Preceding Link (km/hr)	Average Cruising Speed in Subsequent Link (km/hr)	Current Stop Number	Splited (After Consolidation) Boarding Passengers in Preceding Stop	Splited (After Consolidation) Boarding Passengers in Subsequent Stop	Splited (After Consolidation) Alighting Passengers in Preceding Stop	Splited (After Consolidation) Alighting Passengers in Subsequent Stop	Travel Time Savings After Consolidation (minute)	Total Travel Time in Preceding Link	Total Travel Time in Subsequent Link	Average Travel Speed in Preceding Link	Average Travel Speed in Subsequent Link
Primary Data_Table																			
1	1	0	307	0	4	4	4	0	40	1									
2	0	307	288	4	4	13	13	40	45	2									
3	0	288	1199	4	13	5	14	45	30	3									
4	0	1199	841	13	11	10	11	30	31	4									
5	0	841	1136	11	5	17	17	31	38	5									
6	0	1136	677	5	1	5	17	38	17	6									
7	0	677	811	1	16	1	17	17	45	7									
8	0	811	166	16	16	18	19	45	25	8									
9	0	166	1194	16	25	22	25	25	35	9									
10	0	1194	895	25	8	21	21	35	16	10									
11	0	895	632	8	23	10	23	16	25	11									
12	0	632	844	23	18	23	23	25	15	12									
13	0	844	105	18	10	15	20	15	24	13									
14	0	105	602	10	12	13	25	24	31	14									
15	0	602	460	12	17	15	26	31	16	15									
16	0	460	860	17	19	15	24	16	37	16									
17	0	860	205	19	2	21	26	37	45	17									
18	0	205	355	2	10	3	27	45	28	18									
19	0	355	534	10	27	10	27	28	15	19									
20	1	534	0	27	0	0	0	15	0	20									

Figure 3.6: Primary data_table



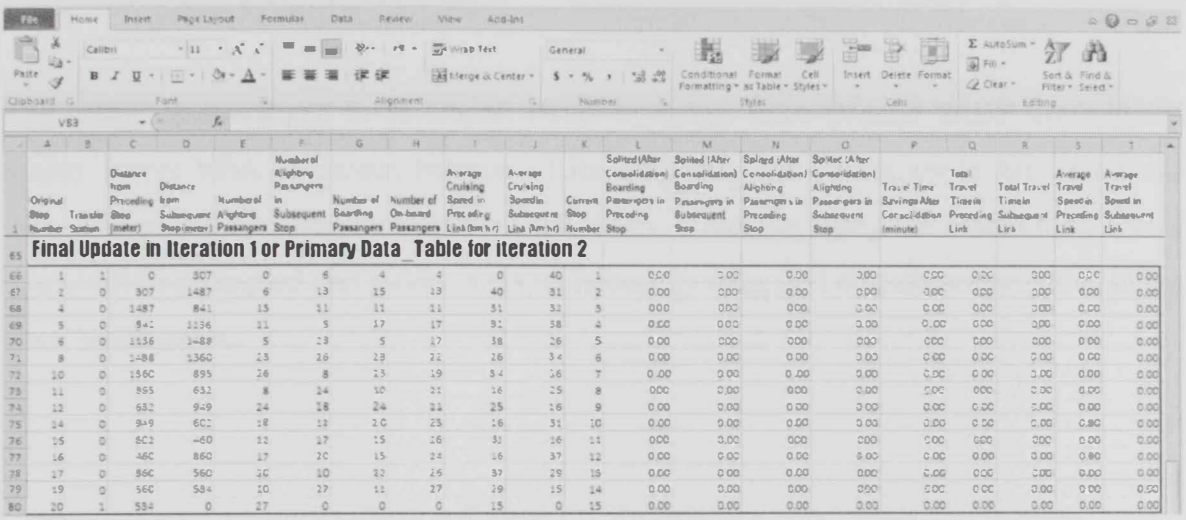
Original Stop Number	Transfer Station	Distance from Preceding Stop (meter)	Distance from Subsequent Stop (meter)	Number of Alighting Passengers	Number of Alighting Passengers in Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Average Cruising Speed in Preceding Link (km/hr)	Average Cruising Speed in Subsequent Link (km/hr)	Current Stop Number	Splited (After Consolidation) Boarding Passengers in Preceding Stop	Splited (After Consolidation) Boarding Passengers in Subsequent Stop	Splited (After Consolidation) Alighting Passengers in Preceding Stop	Splited (After Consolidation) Alighting Passengers in Subsequent Stop	Travel Time Savings After Consolidation (minute)	Total Travel Time in Preceding Link	Total Travel Time in Subsequent Link	Average Travel Speed in Preceding Link	Average Travel Speed in Subsequent Link
Iteration 1: Complete Data_Table																			
1	1	0	307	0	4	4	4	0	40	1					0.00	0.00	41.52	0.00	7.39
2	0	307	288	4	4	13	13	40	45	2	2.90	3.60	1.04	0.96	-7.10	41.52	58.67	7.39	7.45
3	0	288	1199	4	13	5	14	45	30	3	1.95	0.55	1.66	0.84	5.61	38.67	154.30	7.45	7.77
4	0	1199	841	13	11	10	11	30	31	4	1.89	3.11	2.91	3.59	0.00	154.30	108.43	7.77	7.76
5	0	841	1136	11	5	17	17	31	38	5	4.58	3.92	3.35	2.15	0.00	108.43	120.82	7.76	9.40
6	0	1136	677	5	1	5	17	38	17	6	0.87	1.63	1.00	1.50	-6.69	120.82	149.27	9.40	4.54
7	0	677	811	1	16	1	17	17	45	7	0.24	0.26	0.30	0.20	6.83	149.27	80.51	4.54	10.07
8	0	811	166	16	16	18	19	45	25	8	1.39	7.61	1.49	6.51	14.87	80.51	32.58	10.07	5.09
9	0	166	1194	16	25	22	25	25	35	9	9.38	1.62	7.20	0.80	28.52	32.58	134.96	5.09	8.85
10	0	1194	895	25	8	21	21	35	16	10	4.19	6.32	5.74	6.76	0.00	134.96	206.93	8.85	4.33
11	0	895	632	8	23	10	23	16	25	11	1.76	3.24	1.91	1.09	-8.19	206.93	99.69	4.33	6.34
12	0	632	844	23	18	23	23	25	15	12	6.08	5.42	7.06	4.44	-8.86	99.69	207.77	6.34	4.06
13	0	844	105	18	10	15	20	15	24	13	0.65	6.85	1.27	7.73	14.57	207.77	24.08	4.06	4.36
14	0	105	602	10	12	13	23	24	31	14	5.30	1.20	4.41	0.59	9.86	24.08	80.67	4.36	7.46
15	0	602	460	12	17	15	26	31	16	15	2.98	4.52	2.82	5.18	-11.24	80.67	109.06	7.46	4.22
16	0	460	860	17	19	15	24	16	37	16	4.42	3.08	6.03	2.47	-12.67	109.06	86.52	4.22	8.91
17	0	860	205	19	2	21	26	37	45	17	1.53	8.67	2.01	7.48	7.96	86.52	32.03	8.91	6.40
18	0	205	355	2	10	3	27	45	28	18	0.89	0.61	0.67	0.33	9.33	32.03	55.37	6.40	6.41
19	0	355	534	10	27	10	27	28	15	19	2.79	2.21	3.21	1.79	-27.8	55.37	133.37	6.41	4.00
20	1	534	0	27	0	0	0	15	0	20					0.00	133.37	0.00	4.00	0.00

Figure 3.7: Complete data_table



Original Stop Number	Transfer Station	Distance from Preceding Stop (meter)	Distance from Subsequent Stop (meter)	Number of Alighting Passengers	Number of Alighting Passengers in Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Average Cruising Speed in Preceding Link (km/hr)	Average Cruising Speed in Subsequent Link (km/hr)	Current Stop Number	Splited (After Consolidation) Boarding Passengers in Preceding Stop	Splited (After Consolidation) Boarding Passengers in Subsequent Stop	Splited (After Consolidation) Alighting Passengers in Preceding Stop	Splited (After Consolidation) Alighting Passengers in Subsequent Stop	Travel Time Savings After Consolidation (minute)	Total Travel Time in Preceding Link	Total Travel Time in Subsequent Link	Average Travel Speed in Preceding Link	Average Travel Speed in Subsequent Link
Iteration 1: Update after Consolidation																			
1	1	0	307	0	4	4	4	0	40	1					0.00	0.00	41.52	0.00	7.39
2	0	307	1487	5.657198	4	14.95478	13	40	31.03783	2	2.90	3.60	1.04	0.96	-7.12	41.52	181.50	7.39	8.19
Consol	0	188	1199	4	13	5	14	45	30	3	1.95	0.55	1.66	0.34	5.61	38.67	154.30	7.45	7.77
4	0	1487	841	13.9428	11	10.54522	11	31.03783	31	4	1.89	3.11	1.91	3.59	0.00	181.90	108.43	8.19	7.76
5	0	841	1136	11	5	17	17	31	38	5	4.58	3.92	3.85	2.15	0.00	108.43	120.82	7.76	9.40
6	0	1136	1488	5.302556	1	5.2418	17	38	156.8855	6	0.87	1.63	1.00	1.50	-9.59	120.82	216.09	9.40	6.89
Consol	0	677	811	1	16	1	17	45	7	0.24	0.26	0.30	0.20	5.83	149.27	80.51	4.54	10.07
8	0	1488	1360	23.39571	16	27.63536	19	25.62855	33.76514	8	1.59	7.61	1.49	6.51	14.87	216.09	156.09	6.89	8.71
Consol	0	166	1194	16	25	22	25	25	35	9	9.56	1.62	7.20	0.80	28.52	32.58	134.96	5.09	8.85
10	0	1360	895	25.80373	8	12.82184	21	33.76514	16	10	4.18	8.32	5.74	8.76	0.00	156.09	105.93	8.71	4.53
11	0	895	632	8	23	10	23	16	25	11	1.76	8.24	1.91	2.09	-8.19	226.93	99.69	4.33	6.34
12	0	632	949	24.26589	18	23.64739	23	25	15.59654	12	6.68	5.42	7.06	4.44	-38.86	99.69	224.14	6.34	4.23
Consol	0	844	105	18	10	15	20	25	24	13	0.65	9.85	1.27	7.73	24.57	207.77	24.08	4.06	4.36
14	0	949	601	17.73311	12	19.85261	23	15.59654	31	14	5.30	1.20	4.41	0.59	9.86	224.14	80.67	4.23	7.46
15	0	602	460	12	17	15	26	31	16	15	2.98	4.52	2.82	3.18	-11.24	80.67	109.06	7.46	4.22
16	0	460	860	17	19	15	24	16	37	16	4.42	3.08	6.03	2.47	-12.67	109.06	96.52	4.22	8.91
17	0	860	560	19.67329	2	21.88903	26	37	29.3929	17	1.83	8.67	2.02	7.48	7.96	96.52	26.49	8.91	7.32
Consol	0	205	355	2	10	3	27	45	28	18	0.89	0.61	0.67	0.33	9.33	52.09	55.37	6.40	6.41
19	0	560	584	10.32671	27	10.61097	27	29.3929	15	19	2.79	2.21	8.21	1.79	-2.78	26.49	133.37	7.32	4.00
20	1	584	0	27	0	0	0	15	0	20					0.00	133.37	0.00	4.00	0.00

Figure 3.8: Updated data_table after Consolidation



Original Stop Number	Transfer Station	Distance from Preceding Stop (meter)	Distance from Subsequent Stop (meter)	Number of Alighting Passengers	Number of Alighting Passengers in Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Average Cruising Speed in Preceding Link (km/hr)	Average Cruising Speed in Subsequent Link (km/hr)	Current Stop Number	Splited (After Consolidation) Boarding Passengers in Preceding Stop	Splited (After Consolidation) Boarding Passengers in Subsequent Stop	Splited (After Consolidation) Alighting Passengers in Preceding Stop	Splited (After Consolidation) Alighting Passengers in Subsequent Stop	Travel Time Savings After Consolidation (minute)	Total Travel Time in Preceding Link	Total Travel Time in Subsequent Link	Average Travel Speed in Preceding Link	Average Travel Speed in Subsequent Link
Final Update in Iteration 1 or Primary Data_Table for Iteration 2																			
1	1	0	307	0	6	4	4	0	40	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0	307	1487	6	13	15	13	40	31	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	1487	841	15	11	11	11	31	32	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	841	1136	11	5	17	17	32	38	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	1136	1488	5	23	5	17	38	26	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0	1488	1360	23	26	23	21	26	34	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	1360	895	26	8	23	19	34	16	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0	895	632	8	24	10	21	16	25	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	632	949	24	18	24	21	25	16	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	949	602	18	12	20	23	16	31	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0	602	460	12	17	15	26	31	16	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0	460	860	17	20	15	24	16	37	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	860	560	20	10	22	26	37	29	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	560	584	10	27	11	27	29	15	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1	584	0	27	0	0	0	15	0	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 3.9: Final Updated data_table or Primary data_table for Next Iteration

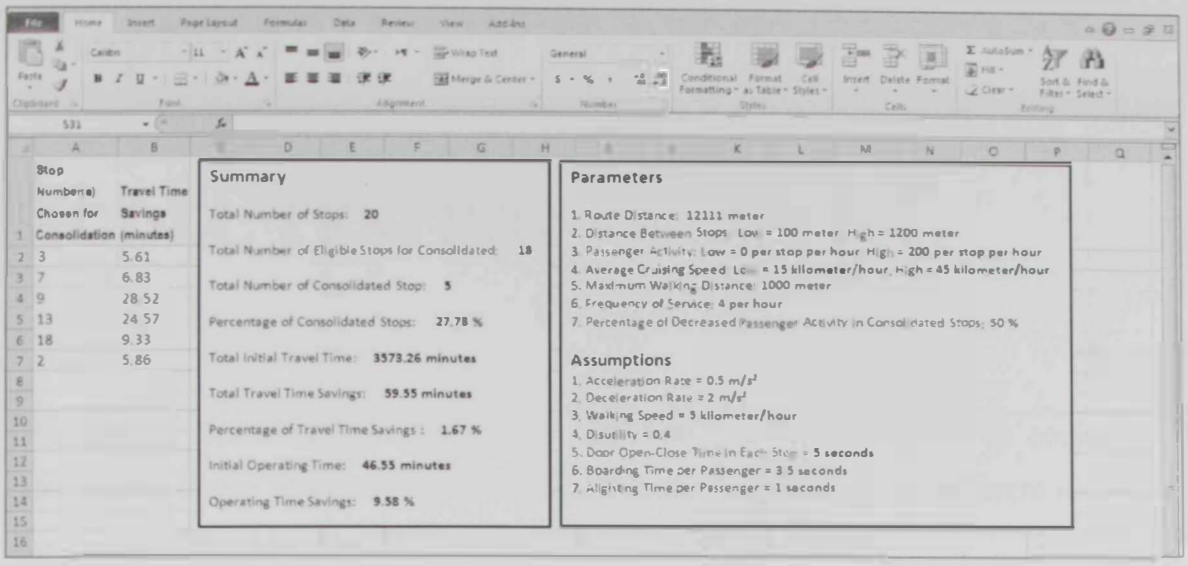


Figure 3.10: Output of Summary Sheet

3.3 Model Developing Tool

The model is developed in Microsoft Excel by using VBA (Visual Basic Application) macro. Excel VBA is chosen because of its simplicity and efficiency to handle tabular data. The model is coded in a user friendly form. It can run using the macro tool, where users will be prompted and guided to input necessary data, and outputs are provided in the excel worksheets.

Chapter 4

MODEL TESTING

This chapter describes how the model was tested to identify flaws in coding and calculations. It also describes the experimental method used to test the different scenarios. The results of the tests were also analyzed and discussed in details.

4.1 Test for Coding and Calculations

Coding and calculations are checked vigorously at each step. A simulator is coded to generate random inputs. Outputs are produced and checked within a separate Excel file that contains step-wise calculations. This process is repeated several times to check the proper execution of the codes. Some errors and inconsistencies were examined throughout this process and corrected. Checking is performed to check:

- Whether the input data are properly read?
- Whether the data table is accurately filled up?
- Whether the eligible stops for consolidation are identified accurately?
- Whether the calculations module is working properly?
- Whether the decisions for stop consolidation are accurate?
- Whether data are updated properly?
- Whether all the necessary outputs are appropriately presented?

4.2 Experiments of the Model

The model is used to test the effects of different input factors in various hypothetical scenarios. A multi-level (mixed) factorial experimental method (Montgomery, 2009) is used for this purpose where all the probable combinations/scenarios can be tested and

analyzed. The objective of the experiments is to determine the most influential factors of stop consolidation.

4.2.1 Selection of Factors and Levels

This research aims at identifying the effects of the model inputs on the outputs/results. This can lead to conclusions on the conditions suitable for stop consolidation. The model has 16 different inputs; six of these were chosen for testing. These probable influential inputs are designated as "factors" (Montgomery, 2009). The identification of these factors was inspired by the literature and formation of the model. The chosen factors include the distance between stops, maximum walkable distance, passengers' activity, average cruising speed, frequency of service and the probable percentage of decreased passengers due to consolidation.

Distance between stops is among the most important factors in the literature (see 2.1.2.1). Usually, stops with close spacing are candidates for consolidation. Despite the fact that the typical trends in US cities are to provide stops closely spaced (100-300 meters) in the business districts, researchers found that a moderate gap (2-3 within a kilometer or 330-500 meters) is a better arrangement. The spacing range (between 100 meter and 1200 meter) is evident in the standards depending on the land use and transit types. Here, this range is divided into four levels; low (100-300 meters), medium (300-500 meters), long (500-700 meters) and very long (700-1200 meters).

Maximum walkable distance is a measure of accessibility. It mainly depends on the environmental condition (hot/cold) and the infrastructure (footpath condition, shed, etc.). Accessibility increases with the increase of maximum walkable distance; the more the walkable distance, the more is the catchment area of a stop. Maximum walkable distance is analyzed in three levels; low (600 meters), medium (800 meters) and long (1000 meters)

Passengers' activity, average cruising speed, frequency of service and percentage of decreased passengers are important factors because they play important role in the model formulation and calculations. Passengers' activity refers to the number of passengers

alighting and boarding during one hour at the stop on a particular route. This factor is divided into four levels. Average cruising speed (divided into 3 levels) is the average speed reached by the transit vehicle after accelerating from a stop. Frequency of service (divided into 3 levels) is the number of transit trips initiated within one hour. Percentage of decreased passengers (divided into 3 levels) is the percentage of passengers assumed to abandon the service if the consolidation takes place. The factors and their levels are summarized in Table 4.1.

Table 4.1 Tested Factors and Levels

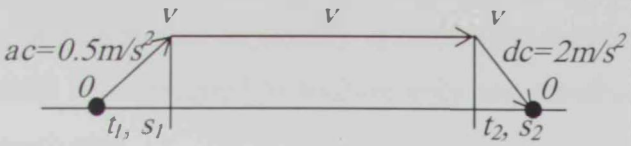
Factors (unit)	Number of Levels	Level 1	Level 2	Level 3	Level 4
Distance between stops (meters)	4	100-300	300-500	500-700	700-1200
Passengers' activity (passengers/hour)	4	0-50	50-100	100-150	150-200
Average cruising speed (km/hr)	3	15-30	30-45	45-60	
Maximum walkable distance (meters)	3	600	800	1000	
Frequency of service (trips/hour)	3	2	4	6	
Percentage of decreased passengers (%)	3	0	25	50	

4.2.2 Selection of Response Variables

Three response variables (outcome measures) are selected from the outputs. These are: the percentage of consolidated stops, percentage of travel time savings and percentage of operating time savings.

4.2.3 Design of the Experiments

The experiments are designed as a multi-level (mixed) factorial experiment. To design a full factorial design with such mixed levels, a total of 1296 (4*4*3*3*3*3) combinations of experiments are needed. There is a correlation between "distance between stops" and "average cruising speed". Figure 4.1 shows that out of 12 combinations of these two factors, 2 combinations cannot be chosen. These two combinations are the 30-45 and 45-60 cruising speed categories of the 100-300 stop spacing category. This reduces the total valid combinations to 1080. Ten runs are performed for each combination, with a total of 10,800 experiments.



Transit vehicle starts accelerating at a rate of $ac = 0.5$ m/s^2 (assumption) from a stop until it reaches the average cruising speed, v. It maintains the speed v, then it decelerates at a rate of $dc = 2$ m/s^2 (assumption) before reaching the next stop.

Calculation of s_1 and s_2

$t_1 = v/ac$	$t_2 = v/dc$
$s_1 = ac*t_1^2/2$	$s_2 = dc*t_3^2/2$
$= v^2/2ac$	$= v^2/2dc$
$= v^2/2*0.5$	$= v^2/2*2$
$= v^2$	$= 0.25v^2$

Minimum distance required to reach a cruising speed of v,

$d_{min} = s_1+s_2 = 1.25v^2$

If,

v=15 km/hr, d_{min} = 22 meter

v=30 km/hr, d_{min} = 87 meter

v=45 km/hr, d_{min} = 195 meter

v=60 km/hr, d_{min} = 247 meter

Distance between stops	Average cruising speed (km/hr)		
	15-30	30-45	45-60
100-300	√	x	x
300-500	√	√	√
500-700	√	√	√
700-1200	√	√	√

From the analysis of the two factors ("distance between stops" and "average cruising speed"), 10 options out of the12 (4*3) combinations are found to be valid.

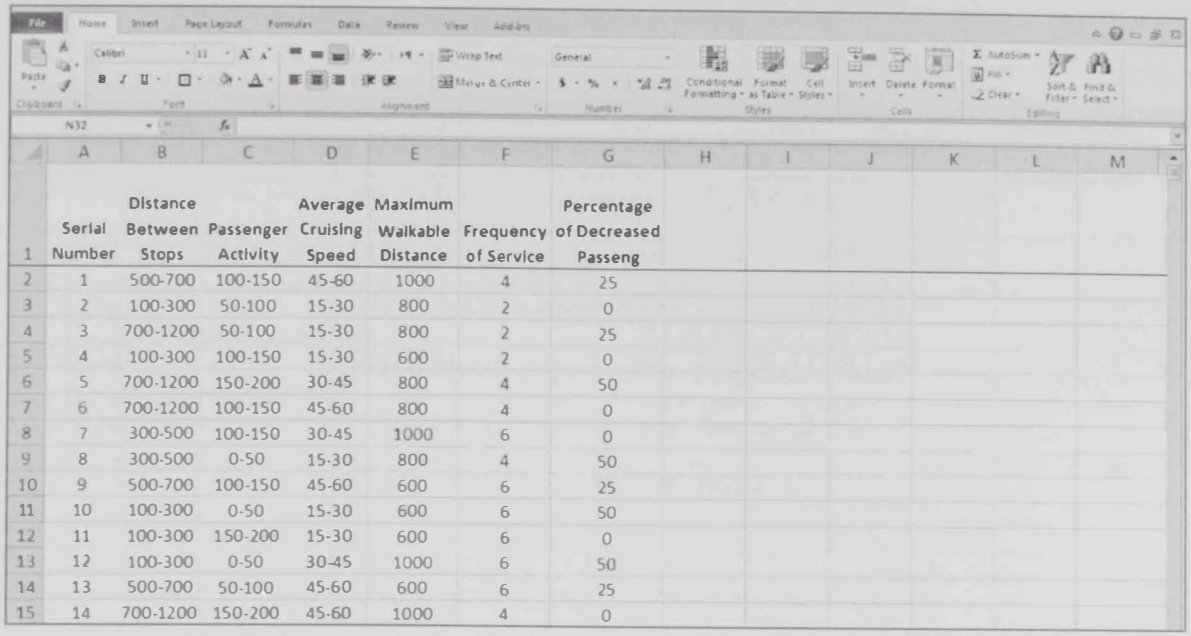
Figure 4.1: Combinations of Valid Scenarios

The combinations were designed and listed (1080 combinations) in Minitab software. The list was then exported to MS Excel software and randomized. A part of that list is shown in Figure 4.2.

4.2.4 Adjusting the Model

The model was adjusted to carry out the excessive number of experiments (10,800). To expedite the execution, the "Data Update" outputs were removed from codes. Some adjustments were done in the "Input" and "Output" modules. The original model is iterative in nature, and data changes after each iteration, with updates to the data_table. In

the adjusted model, the input variables (factors) should be consistent, which means all input data should be exactly or within the range of the given combinations. The adjusted model was designed to analyze only one situation at a time, updates and iterations were deactivated.



	A	B	C	D	E	F	G
1	Serial Number	Distance Between Stops	Passenger Activity	Average Cruising Speed	Maximum Walkable Distance	Frequency of Service	Percentage of Decreased Passeng
2	1	500-700	100-150	45-60	1000	4	25
3	2	100-300	50-100	15-30	800	2	0
4	3	700-1200	50-100	15-30	800	2	25
5	4	100-300	100-150	15-30	600	2	0
6	5	700-1200	150-200	30-45	800	4	50
7	6	700-1200	100-150	45-60	800	4	0
8	7	300-500	100-150	30-45	1000	6	0
9	8	300-500	0-50	15-30	800	4	50
10	9	500-700	100-150	45-60	600	6	25
11	10	100-300	0-50	15-30	600	6	50
12	11	100-300	150-200	15-30	600	6	0
13	12	100-300	0-50	30-45	1000	6	50
14	13	500-700	50-100	45-60	600	6	25
15	14	700-1200	150-200	45-60	1000	4	0

Figure 4.2: List of the Combinations in MS Excel

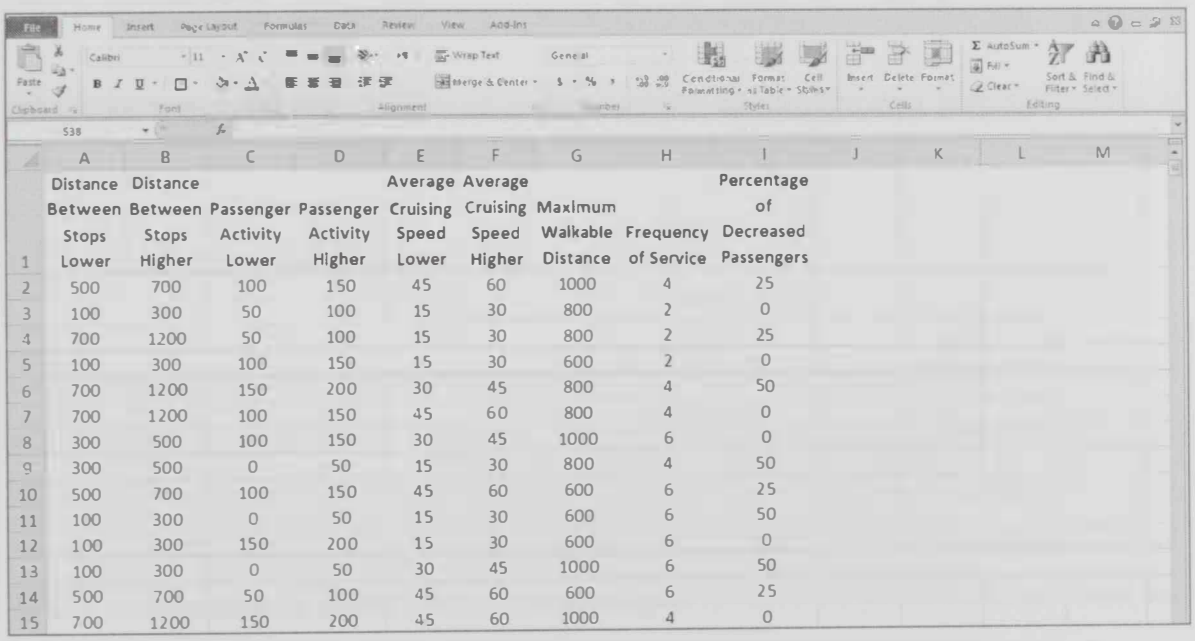
The codes are written in a way so that it takes each combination as input, run 10 experiments (runs) and provide specific outputs. The combination list (Figure 4.2) is slightly modified (Figure 4.3). The modification is mainly to separate the range values of each factor into higher and lower values. The code was written to choose a random value between these lower and higher ends. Therefore, the input part is simulated according to the combination of the factors (experiment). This modified code can be termed as the "Simulator". The input data for the *Simulator* is described in Table 4.2.

Table 4.2 Input Data for the *Simulator*

No.	Variable Name*	Comments
1	Stop_no	20 stops are assumed. Serial Number 1 to 20
2	Transfer	Only origin and destination stops are assumed as transfer stops
3	Dp	Generated from upper and lower bounds of *distance between stops*

4	A	First, *passengers' activity* is generated from upper and lower bounds. Then, A and B are generated as percentage of *passengers' activity*. Condition: on-board passengers cannot be negative.
5	B	
6	vP	Generated from upper and lower bounds of *average cruising speed*
7	Per	Fixed for each experiment (0%, 25% or 50%)
8	Max_dist	Fixed for each experiment (600, 800 or 1000)
9	Frequency	Fixed for each experiment (2, 4 or 6)
10	Ac	Fixed for all experiments. Assumed 0.5 m/s^2
11	Dc	Fixed for all experiments. Assumed 2 m/s^2
12	Vw	Fixed for all experiments. Assumed 5 km/hr
13	Disutility	Fixed for all experiments. Assumed 0.4
14	Door	Fixed for all experiments. Assumed 5 seconds
15	B_Time_per_Pax	Fixed for all experiments. Assumed 3.5 seconds
16	A_Time_per_pax	Fixed for all experiments. Assumed 1 second

*see description in Table 3.1

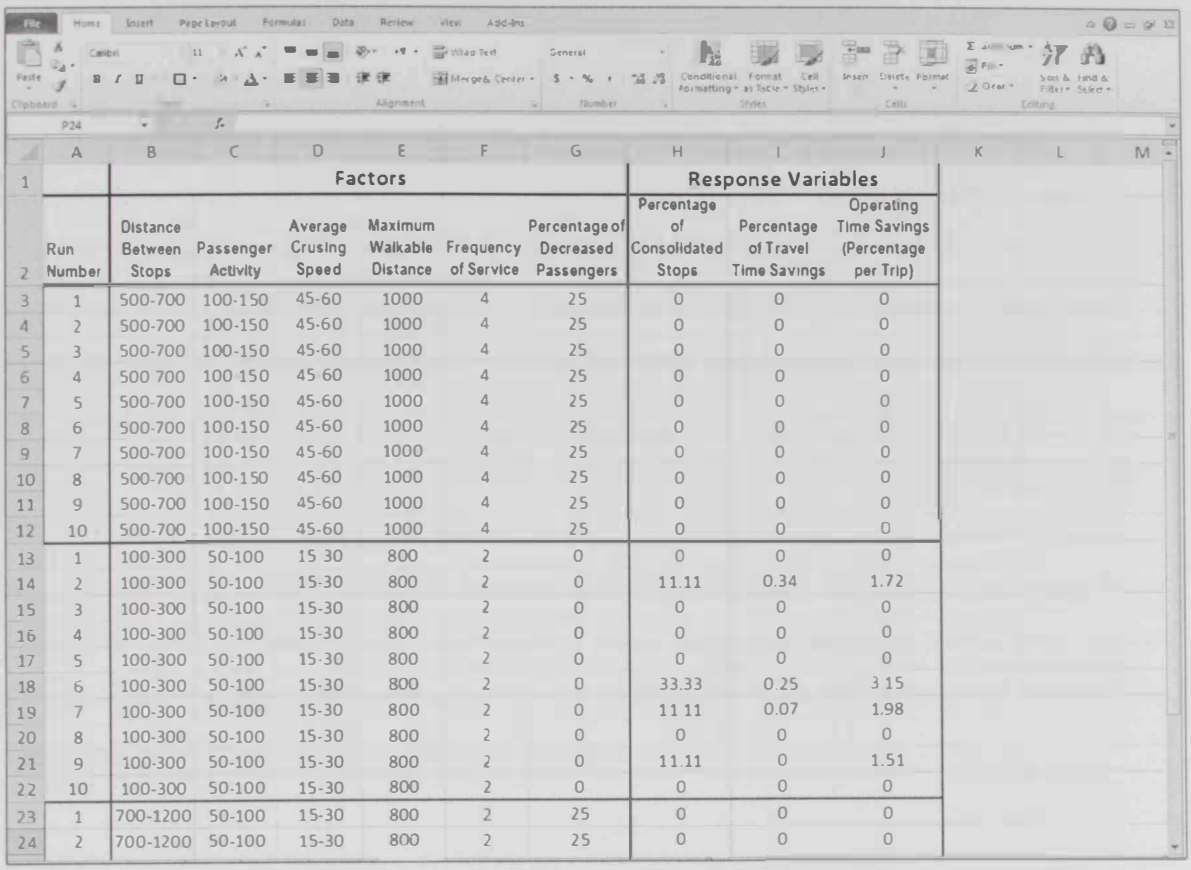


	A	B	C	D	E	F	G	H	I
1	Distance Between Stops Lower	Distance Between Stops Higher	Passenger Activity Lower	Passenger Activity Higher	Average Cruising Speed Lower	Average Cruising Speed Higher	Maximum Walkable Distance	Frequency of Service	Percentage of Decreased Passengers
2	500	700	100	150	45	60	1000	4	25
3	100	300	50	100	15	30	800	2	0
4	700	1200	50	100	15	30	800	2	25
5	100	300	100	150	15	30	600	2	0
6	700	1200	150	200	30	45	800	4	50
7	700	1200	100	150	45	60	800	4	0
8	300	500	100	150	30	45	1000	6	0
9	300	500	0	50	15	30	800	4	50
10	500	700	100	150	45	60	600	6	25
11	100	300	0	50	15	30	600	6	50
12	100	300	150	200	15	30	600	6	0
13	100	300	0	50	30	45	1000	6	50
14	500	700	50	100	45	60	600	6	25
15	700	1200	150	200	45	60	1000	4	0

Figure 4.3: Modified List of the Combinations for Input

In the *Simulator*, the output module is also modified. The details of each experiment (exists in the original model) are excluded to enable fast execution. The output contains

only one worksheet, which shows the factors and the response variables (outcome measures) of all the 10,800 experiments. As each experiment has only one iteration, out of the 20 stops, the highest 9 stops[1] can be consolidated. The percentage of consolidated stops is calculated from the 9 eligible stops. A part of the output is shown in Figure 4.4.



		Factors						Response Variables		
	Run Number	Distance Between Stops	Passenger Activity	Average Cruising Speed	Maximum Walkable Distance	Frequency of Service	Percentage of Decreased Passengers	Percentage of Consolidated Stops	Percentage of Travel Time Savings	Operating Time Savings (Percentage per Trip)
3	1	500-700	100-150	45-60	1000	4	25	0	0	0
4	2	500-700	100-150	45-60	1000	4	25	0	0	0
5	3	500-700	100-150	45-60	1000	4	25	0	0	0
6	4	500 700	100 150	45 60	1000	4	25	0	0	0
7	5	500-700	100-150	45-60	1000	4	25	0	0	0
8	6	500-700	100-150	45-60	1000	4	25	0	0	0
9	7	500-700	100-150	45-60	1000	4	25	0	0	0
10	8	500-700	100-150	45-60	1000	4	25	0	0	0
11	9	500-700	100-150	45-60	1000	4	25	0	0	0
12	10	500-700	100-150	45-60	1000	4	25	0	0	0
13	1	100-300	50-100	15 30	800	2	0	0	0	0
14	2	100-300	50-100	15-30	800	2	0	11.11	0.34	1.72
15	3	100-300	50-100	15-30	800	2	0	0	0	0
16	4	100-300	50-100	15-30	800	2	0	0	0	0
17	5	100-300	50-100	15-30	800	2	0	0	0	0
18	6	100-300	50-100	15-30	800	2	0	33.33	0.25	3 15
19	7	100-300	50-100	15-30	800	2	0	11 11	0.07	1.98
20	8	100-300	50-100	15-30	800	2	0	0	0	0
21	9	100-300	50-100	15-30	800	2	0	11.11	0	1.51
22	10	100-300	50-100	15-30	800	2	0	0	0	0
23	1	700-1200	50-100	15-30	800	2	25	0	0	0
24	2	700-1200	50-100	15-30	800	2	25	0	0	0

Figure 4.4: Part of the *Simulator* Output

4.2.5 Analysis of the Experiments

The outputs of the experiments were analyzed in Minitab software. Descriptive statistics were generated to compare the mean values of different groups (specific levels of factors). The effects of the factors are analyzed using analysis of variance (ANOVA), which is widely used to compute the statistical significance of factorial effects. For the ANOVA tests, general linear models are developed for each response variable. Here, the

[1] From 20 stops, origin and destination stops cannot be consolidated. As a result, only 18 stops can be considered for consolidation. The model assumes that the adjacent stops have to be kept, even though they may produce positive travel time savings (see section 3.2.5). Therefore, out of the 18 stops, highest 9 (18/2=9) stops can be consolidated. It is worth noting that the 9 stops are the maximum number of stops that can be consolidated. In any experiment, the number of consolidated stops ranges between 0 and 9.

main effects of each factor and probable interaction effects (only second order interactions) were estimated, plotted and discussed. Finally, the correlation between the factors and the response variables were estimated.

4.2.5.1 Descriptive Statistics

The descriptive statistics of all the factors are shown in Table 4.3. Here, the minimum, maximum, mean and standard deviation values of the response variables are reported according to the levels of each factor. For example, for the response variable *percentage of consolidated stops*, if the *distance between stops* is in the low level (100-300m), the mean value is 28.508 (irrespective to the levels of the other factors). Mean values of *average cruising speed, maximum walkable distance* and *frequency of service* suggest that the responses are not significantly varied, irrespective of their levels. The three factors (*distance between stops, passengers' activity* and *percentage of decreased passengers*) show different mean values according to their levels. Mean values of *distance between stops* shows variability with all three response variables. *Passengers' activity* shows variability with *percentage of consolidated stops* and *percentage of travel time savings*. *Percentage of decreased passengers* shows variability with *percentage of consolidated stops* and *percentage of operating time savings*.

4.2.5.2 Analysis of Variance (ANOVA)

The ANOVA results for the *percentage of consolidated stops* and outcome measures are shown in Table 4.4. The considerable effects are highlighted in the table. *Distance between stops* shows the largest effect on the *percentage of consolidated stops*. The next largest effects are the *passengers' activity*, the interaction between the *passengers' activity* and the *percentage of decreased passengers*, the *percentage of decreased passengers*, and finally the interaction effect between the *distance between stops* and *passengers' activity*. The adjusted r^2 value of the model is 73.46%.

Table 4.3 Descriptive Statistics of the Experiments

Factors and Levels / Response Variables		*Percentage of Consolidated Stop*				*Percentage of Travel Time Savings*				*Percentage of Operating Time Savings*			
		Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Distance between stops	100-300	0.00	100.00	28.508	27.804	0.00	4.83	0.4406	0.6274	0.00	27.330	5.382	6.1280
	300-500	0.00	88.89	9.125	16.142	0.00	3.76	0.17758	0.40072	0.00	20.360	1.1821	2.3324
	500-700	0.00	66.67	4.811	11.332	0.00	5.10	0.11716	0.34447	0.00	11.490	0.5602	1.4286
	700-1200	0.00	55.56	0.895	4.4601	0.00	1.79	0.01885	0.10750	0.00	6.9700	0.07702	0.4358
Passengers' activity	0-50	0.00	100.00	20.933	21.478	0.00	5.10	0.5003	0.6573	0.00	22.330	2.6339	3.4479
	50-100	0.00	88.89	3.757	12.526	0.00	2.82	0.03433	0.15580	0.00	22.100	0.7591	2.6469
	100-150	0.00	100.00	4.860	15.127	0.00	2.29	0.04543	0.16998	0.00	27.330	1.0572	3.5128
	150-200	0.00	100.00	7.403	19.304	0.00	1.92	0.07771	0.22856	0.00	27.130	1.5655	4.4074
Average cruising speed	15-30	0.00	100.00	9.660	19.037	0.00	3.78	0.13499	0.32510	0.00	25.160	1.3338	3.3019
	30-45	0.00	100.00	11.674	21.097	0.00	4.83	0.22564	0.50745	0.00	27.330	2.1562	4.4624
	45-60	0.00	66.67	3.523	10.065	0.00	5.10	0.10093	0.34842	0.00	11.490	0.5397	1.5464
Maximum walkable distance	600	0.00	100.00	8.071	18.213	0.00	3.76	0.13895	0.39141	0.00	27.010	1.3894	3.5963
	800	0.00	100.00	9.583	19.152	0.00	5.10	0.17433	0.43588	0.00	26.890	1.5608	3.6962
	1000	0.00	100.00	10.061	18.870	0.00	3.78	0.18003	0.41529	0.00	27.330	1.5615	3.5921
Frequency of service	2	0.00	100.00	11.889	21.846	0.00	2.45	0.12845	0.27059	0.00	27.330	1.9931	4.4565
	4	0.00	100.00	8.086	17.091	0.00	3.73	0.15256	0.37912	0.00	22.670	1.3123	3.2095
	6	0.00	88.89	7.740	16.637	0.00	5.10	0.21230	0.54402	0.00	23.710	1.2064	2.9988
Percentage of decreased passengers	0	0.00	88.89	4.592	11.030	0.00	3.65	0.11324	0.34395	0.00	12.800	0.5139	1.3846
	25	0.00	88.89	6.586	14.400	0.00	5.10	0.13274	0.37228	0.00	16.400	0.9160	2.2160
	50	0.00	100.00	16.537	25.412	0.00	4.83	0.24733	0.49925	0.00	27.330	3.0818	5.3734

Table 4.4 ANOVA for the *Percentage of Consolidated Stops* Outcome Measure, Using Adjusted SS

Source	Seq SS	%
Factors		
Distance Between Stops	1091121	28.69
Passengers' activity	511254	13.44
Average Cruising Speed	10217	0.27
Maximum Walkable Distance	7773	0.20
Frequency of Service	38143	1.00
Percentage of Decreased Passengers	294800	7.75
Interactions of Factors		
*Distance Between Stops * Passengers' activity*	193625	5.09
*Distance Between Stops * Average Cruising Speed*	6082	0.16
*Distance Between Stops * Maximum Walkable Distance*	16097	0.42
*Distance Between Stops * Frequency of Service*	107190	2.82
*Distance Between Stops * Percentage of Decreased Passengers*	432007	11.36
*Passengers' activity * Average Cruising Speed*	6347	0.17
*Passengers' activity * Maximum Walkable Distance*	25706	0.68
*Passengers' activity * Frequency of Service*	32980	0.87
*Passengers' activity * Percentage of Decreased Passengers*	14119	0.37
*Average Cruising Speed * Maximum Walkable Distance*	470	0.01
*Average Cruising Speed * Frequency of Service*	256	0.01
*Average Cruising Speed * Percentage of Decreased Passengers*	3117	0.08
*Maximum Walkable Distance * Frequency of Service*	433	0.01
*Maximum Walkable Distance * Percentage of Decreased Passengers*	1135	0.03
*Frequency of Service * Percentage of Decreased Passengers*	9608	0.25
Error	1000649	26.31
Total	3803128	100
R-Sq = 73.69% , R-Sq(adj) = 73.46%		

Figure 4.5 shows the main effects plot for the *percentage of consolidated stops* outcome measure. *Distance between stops, passengers' activity* and *percentage of decreased*

passengers show some variability with the response variable (*percentage of consolidated stops*). The three factors do not show considerable variability. The *percentage of consolidated stops* shows a clear negative relationship with *distance between stops*, a clear positive relationship with *percentage of decreased passengers*. That is, the *percentage of consolidated stops* is highest when the *distance between stops* is lowest, and the *percentage of decreased passengers* is highest. *Percentage of consolidated stops* shows unclear relationship with the *passengers' activity*. A low *passengers' activity* (25 per hour) shows higher percentage of consolidation, which is sharply decreased if the *passengers' activity* is slightly increased. If the *passengers' activity* is increased further, the *percentage of consolidated stops* starts to increase slightly.

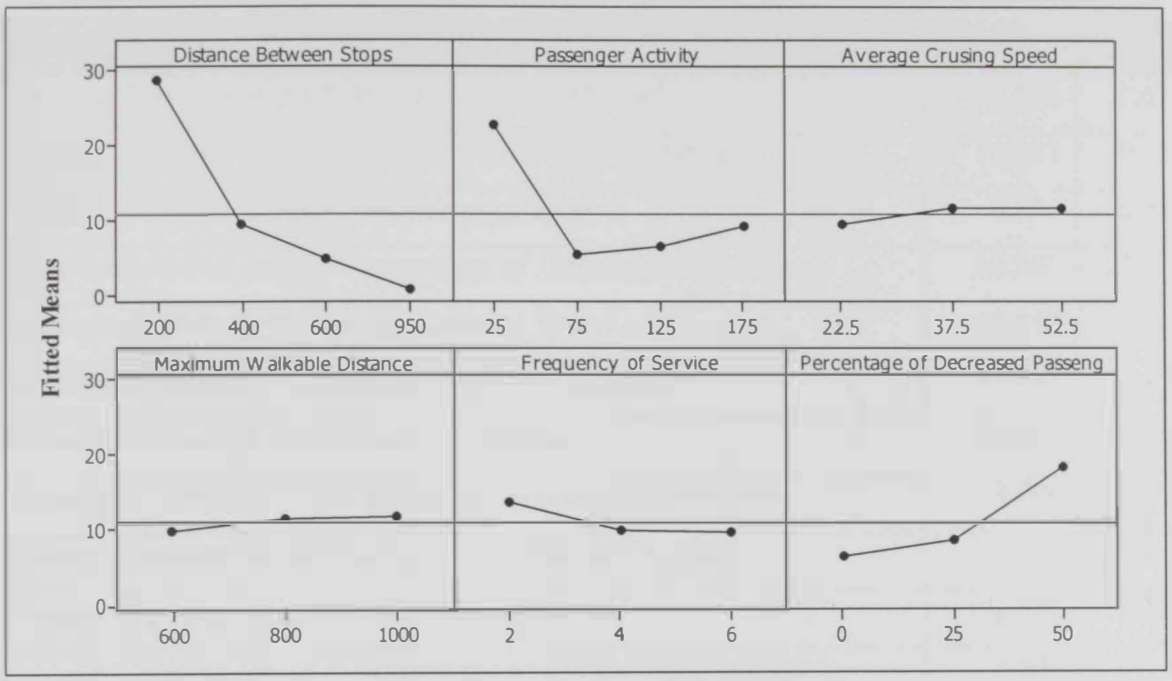


Figure 4.5: Main Effects Plot for *Percentage of Consolidated Stops*

The ANOVA table for *percentage of travel time savings* is given in Table 4.5. The considerable effects are highlighted in the table. The *passengers' activity* shows the largest effect on the *percentage of travel time savings*. The next largest effects are noticed for the *distance between stops*, followed by the interaction between the *passengers' activity* and the *distance between stops*. The adjusted r^2 value of the model is 60.41%.

Table 4.5 ANOVA for *Percentage of Travel Time Savings* Outcome Measure, Using Adjusted SS

Source	Seq SS	%
Factors		
Distance Between Stops	241.027	12.96
Passengers' activity	408.789	21.98
Average Cruising Speed	21.265	1.14
Maximum Walkable Distance	3.567	0.19
Frequency of Service	13.418	0.72
Percentage of Decreased Passengers	37.792	2.03
Interactions of Factors		
*Distance Between Stops * Passengers' activity*	160.908	8.65
*Distance Between Stops * Average Cruising Speed*	12.528	0.67
*Distance Between Stops * Maximum Walkable Distance*	10.181	0.55
*Distance Between Stops * Frequency of Service*	6.391	0.34
*Distance Between Stops * Percentage of Decreased Passengers*	56.967	3.06
*Passengers' activity * Average Cruising Speed*	40.152	2.16
*Passengers' activity * Maximum Walkable Distance*	13.983	0.75
*Passengers' activity * Frequency of Service*	86.626	4.66
*Passengers' activity * Percentage of Decreased Passengers*	8.796	0.47
*Average Cruising Speed * Maximum Walkable Distance*	0.997	0.05
*Average Cruising Speed * Frequency of Service*	2.542	0.14
*Average Cruising Speed * Percentage of Decreased Passengers*	2.400	0.13
*Maximum Walkable Distance * Frequency of Service*	0.279	0.02
*Maximum Walkable Distance * Percentage of Decreased Passengers*	0.318	0.02
*Frequency of Service * Percentage of Decreased Passengers*	0.640	0.03
Error	729.837	39.25
Total	1859.402	100
R-Sq = 60.75% , R-Sq(adj) = 60.41%		

Figure 4.6 shows the main effects plot for the *percentage of travel time savings* outcome measure. The *distance between stops* and the *passengers' activity* shows some variability with the response variable (*percentage of travel time savings*). The other four factors do

not show considerable variability. The *percentage of travel time savings* shows a clear negative relationship with *distance between stops*. That is the *percentage of travel time savings* is highest when *distance between stops* is lowest and vice versa. The *percentage of travel time savings* shows unclear relationship with *passengers' activity*. A low *passengers' activity* (25 per hour) shows higher percentage of consolidation, which is sharply decreased if the *passengers' activity* is slightly increased. If the *passengers' activity* increased further, the *percentage of travel time savings* starts to slightly increase.

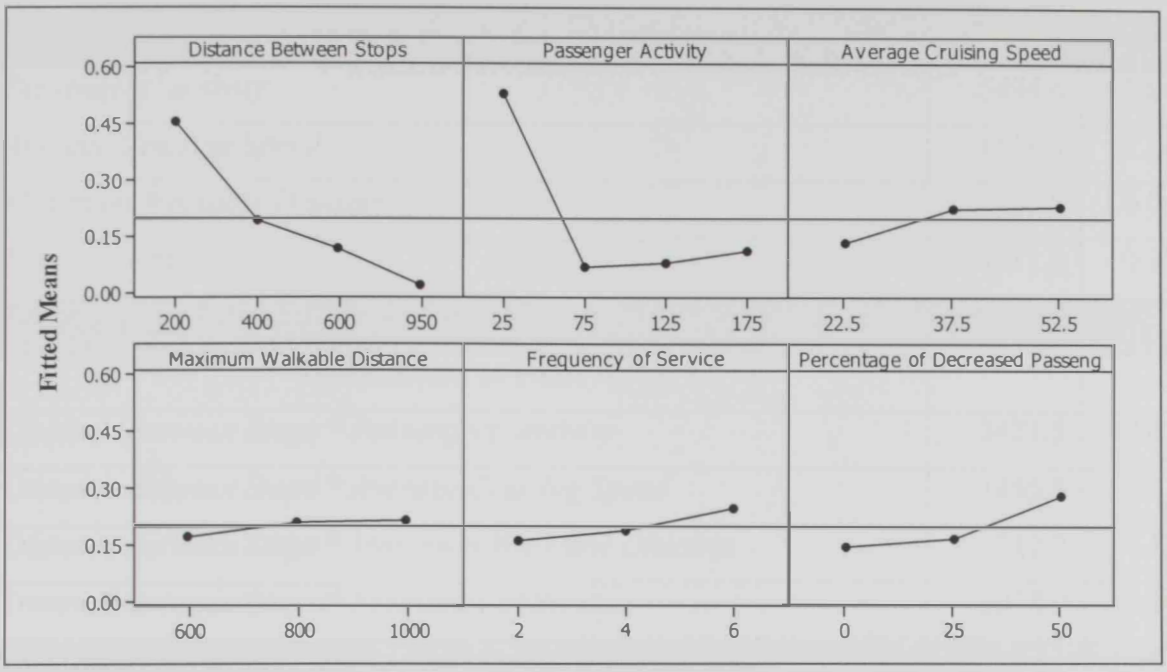


Figure 4.6: Main Effects Plot for *Percentage of Travel Time Savings*

The ANOVA table for the *percentage of operating time savings* outcome measure is given in Table 4.6. The considerable effects are highlighted in the table. The *distance between stops* shows the largest effects on the *percentage of operating time savings* outcome. The next largest effects are due to the interaction between the *distance between stops* and *percentage of decreased passengers*, followed by the effect of the *percentage of decreased passengers*. The adjusted r^2 value of the model is 73.77%.

Figure 4.7 shows the main effects plot for the *percentage of operating time savings* outcome measure. The *distance between stops* and the *percentage of decreased passengers* shows some variability with the response variable (*percentage of operating time savings*). The other four factors do not show clear or considerable variability. The *percentage of operating time savings* shows a clear negative relationship with the

distance between stops, and a clear positive relationship with the *percentage of decreased passengers*. That is the *percentage of operating time savings* is highest when the *distance between stops* is lowest and the *percentage of decreased passengers* is highest.

Table 4.6 ANOVA for *Percentage of Operating Time Savings* Outcome Measure, Using Adjusted SS

Source	Seq SS	%
Factors		
Distance Between Stops	42184.8	29.66
Passengers' activity	5494.6	3.86
Average Cruising Speed	1619.4	1.14
Maximum Walkable Distance	70.8	0.05
Frequency of Service	1312.2	0.92
Percentage of Decreased Passengers	13735.5	9.66
Interactions of Factors		
*Distance Between Stops * Passengers' activity*	3421.5	2.41
*Distance Between Stops * Average Cruising Speed*	1455.8	1.02
*Distance Between Stops * Maximum Walkable Distance*	212.7	0.15
*Distance Between Stops * Frequency of Service*	3224.9	2.27
*Distance Between Stops * Percentage of Decreased Passengers*	27278.3	19.18
*Passengers' activity * Average Cruising Speed*	1184.2	0.83
*Passengers' activity * Maximum Walkable Distance*	255.6	0.18
*Passengers' activity * Frequency of Service*	1515.6	1.07
*Passengers' activity * Percentage of Decreased Passengers*	626.1	0.44
*Average Cruising Speed * Maximum Walkable Distance*	43.4	0.03
*Average Cruising Speed * Frequency of Service*	10.5	0.01
*Average Cruising Speed * Percentage of Decreased Passengers*	541.1	0.38
*Maximum Walkable Distance * Frequency of Service*	12.1	0.01
*Maximum Walkable Distance * Percentage of Decreased Passengers*	21.3	0.01
*Frequency of Service * Percentage of Decreased Passengers*	1016.7	0.71
Error	36987.7	26.01
Total	142224.7	100
R-Sq = 73.99% , R-Sq(adj) = 73.77%		

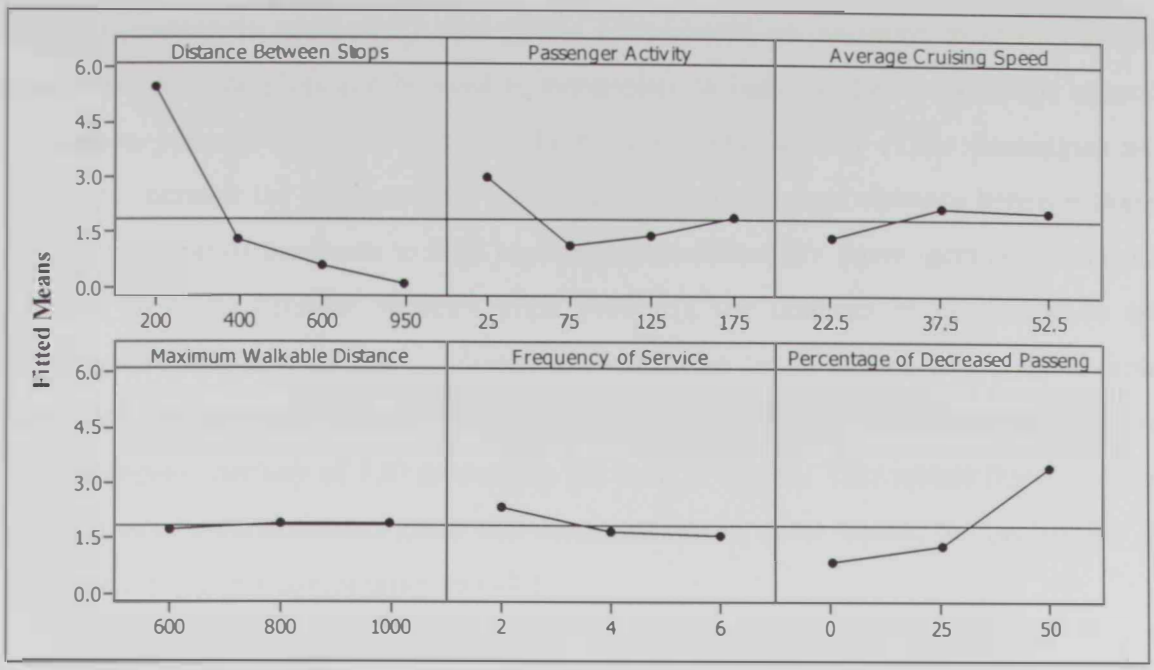


Figure 4.7: Main Effects Plot for *Percentage of Operating Time Savings*

4.2.5.3 Interaction of Factors

The interactions between any two factors were analyzed by surface generation and contour plotting. These plots can be used to describe the response for any combination within the boundary limits of the factors. Following the analysis in Tables 4.4 to 4.6, four interactions were found to be prominent (the Sum of Square is more than 5%, as highlighted in these tables). These interactions are plotted using (A) Contour, and (B) Surface Plots, in Figures 4.8 to 4.11.

Figure 4.8 shows the effect of interaction between the *distance between stops* and the *passengers' activity* on the *percentage of consolidated stops* response variable. It shows that the *percentage of consolidated stops* is highest (40%+) when the *passengers' activity* is lowest (<50per hour) and the *distance between stops* is the lowest (<200m). The *percentage of consolidated stops* is 30-40% when the *distance between stops* is around 200-300m and the *passengers' activity* is less than 50 passengers per hour. The *percentage of consolidated stops* further decreased to 20-30% when the *distance between stops* is around 300-400m and the *passengers' activity* is around 50-80 passengers per hour. An interesting note is that the same *percentage of consolidated stops* (20-30%) can also be achieved at lowest *distance between stops* (<200m) and *passengers' activity* more

than 150 passengers per hour. Although the experiments are bounded to certain levels, contour and surface plots can be used to extrapolate to indicate the relationships beyond the bounds. Here, it indicates that very high *passengers' activity* (150+ passengers per hour) may increase the *percentage of consolidated stops* at lower *distance between stops*. In a combination of moderate to high *passengers' activity* (50+ passengers per hour) and moderate to high *distance between stops* (400+m), the chances of consolidation are minimal. The response to any combination (within the limit) can be extrapolated from these plots. For example, the response of the combination *distance between stops* of 400m and *passengers' activity* of 120 passengers per hour is 0-10%. This means that 0-10% of the stops can be consolidated given this combination. In other words, the probability of consolidation for this combination is 0-0.1.

Figure 4.9 shows the effect of the interaction between the *distance between stops* and *percentage of decreased passengers* on the *percentage of consolidated stops* response variable. It shows that the *percentage of consolidated stops* is highest (40%+) when the *percentage of decreased passengers* is highest (50%) and *distance between stops* is lowest (<200m). The *percentage of consolidated stops* is 30-40% when the *distance between stops* is around 200-300m and the *percentage of decreased passengers* is more than 30%. The *percentage of consolidated stops* further decreased to 20-30% when the *distance between stops* is around 200-300m and *percentage of decreased passengers* is around 20-50%. In a combination of moderate to high *distance between stops* (500+m) and a 0-40% *percentage of decreased passengers*, the chances of consolidation are minimal. The plots can also be used to indicate the probable response of any combination within the factors limits. For example, the response of the combination of the *distance between stops* of 400m and the *percentage of decreased passengers* of 30% is 10-20%. This indicates that 10-20% of the stops can be consolidated given this combination, or that the probability of consolidation for this combination is 0.1-0.2.

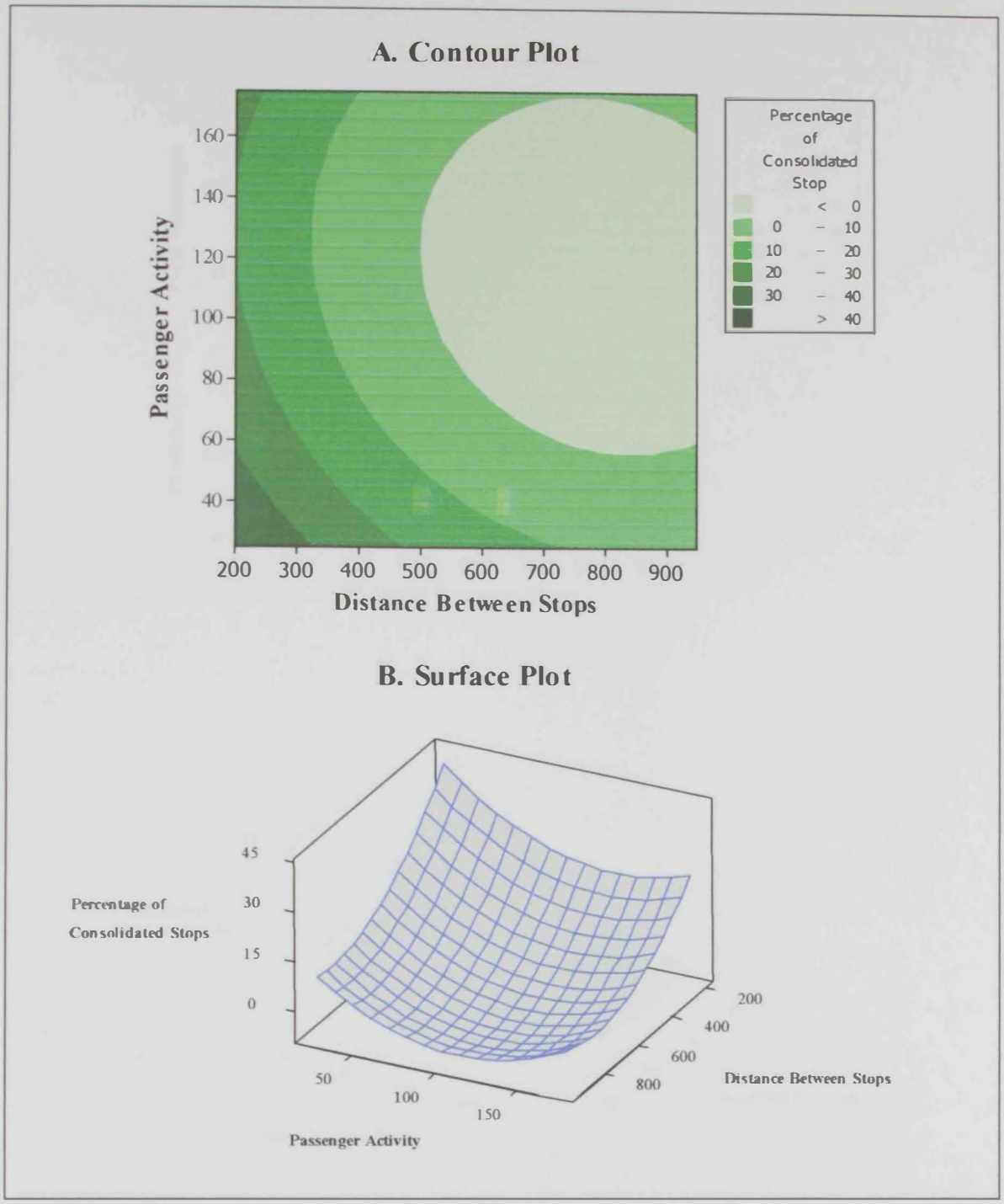


Figure 4.8: The *Percentage of Consolidated Stops* Versus *Distance between Stops* and *Passengers' Activity*

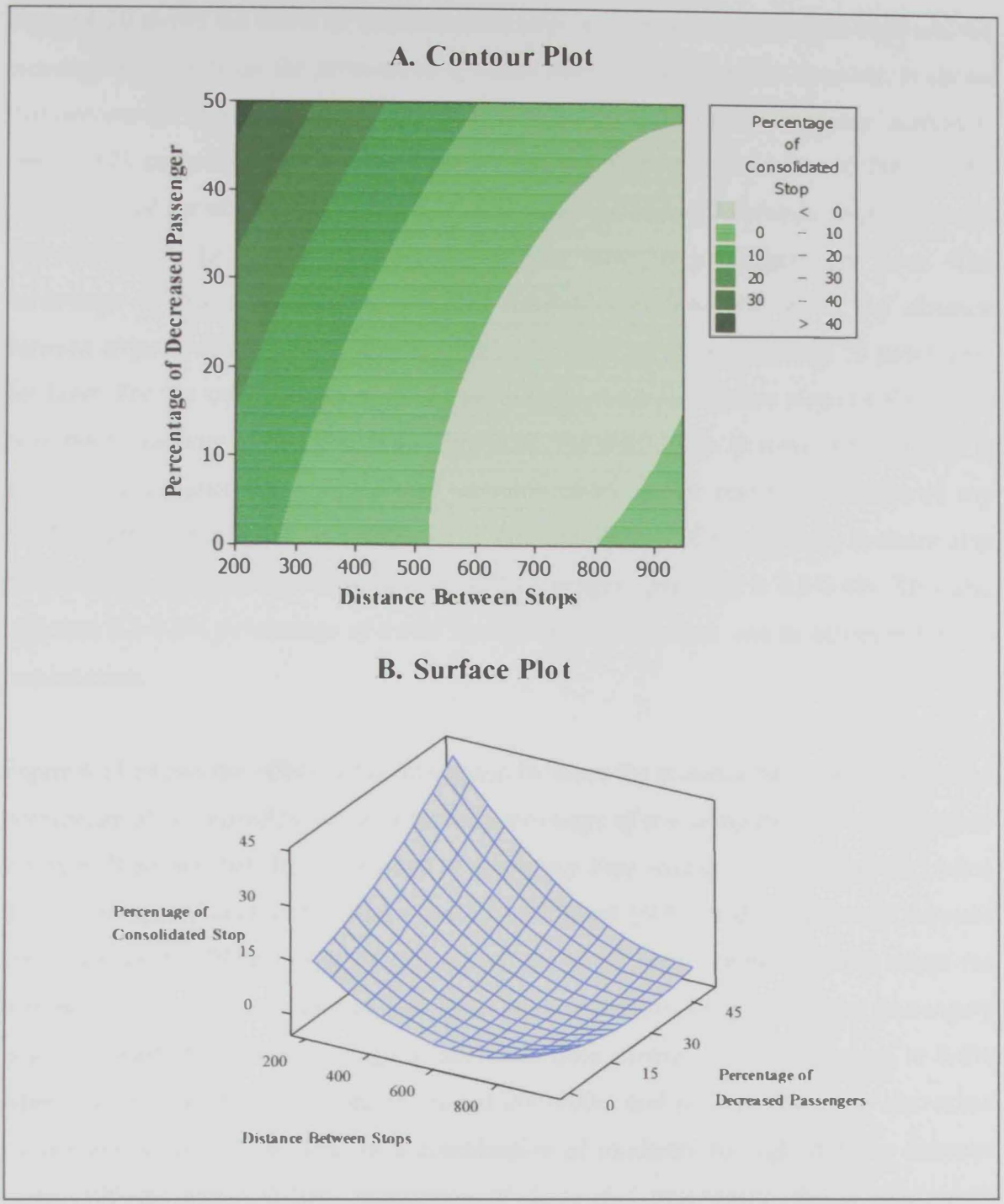


Figure 4.9: The *Percentage of Consolidated Stops* versus *Distance between Stops* and *Percentage of Decreased Passengers*

Figure 4.10 shows the effect of the interaction between the *distance between stops* and the *passengers' activity* on the *percentage of travel time savings* response variable. It shows that *percentage of travel time savings* is highest (0.8%+) when the *passengers' activity* is lowest (<50 passengers per hour) and *distance between stops* is also lowest (<200m). The *percentage of travel time savings* is 0.6-0.8% when the *distance between stops* is around 200-400m and the *passengers' activity* is less than 50 passengers per hour. The *percentage of travel time savings* further decreased to 0.4-0.6% when the *distance between stops* is around 200-600m and the *passengers' activity* is around 70 passengers per hour. For the combination of moderate to high *distance between stops* (400+m) and *passengers' activity* of 60+ passengers per hour, the *percentage of travel time savings* is minimal. The figure can also indicate probable effect on the response variable of any combination. For example, the response of the combination of the *distance between stop* of 400m and the *passengers' activity* of 120 passengers per hour is 0.2-0.4%. This also indicates 0.2-0.4% *percentage of travel time savings* of the users can be achieved for this combination.

Figure 4.11 shows the effect of the interaction between the *distance between stops* and the *percentage of decreased passengers* on the *percentage of operating time savings* response variable. It shows that the *percentage of operating time savings* is highest (8%+) when the *percentage of decreased passengers* is the highest (50%) and the *distance between stops* is lowest (<200m). The *percentage of operating time savings* is 6-8% when the *distance between stops* is around 200-300m and the *percentage of decreased passengers* is around 40-50%. The *percentage of operating time savings* further decreased to 4-6% when the *distance between stops* is around 200-400m and the *percentage of decreased passengers* is around 20-50%. In a combination of moderate to high *distance between stops* (500+m) and a 0-40% *percentage of decreased passengers*, the *percentage of operating time savings* is minimal. The response of the combination of the *distance between stops* of 350m and the *percentage of decreased passengers* of 30% is 2-4%. This indicates that 2-4% of the operating time can be saved for this combination.

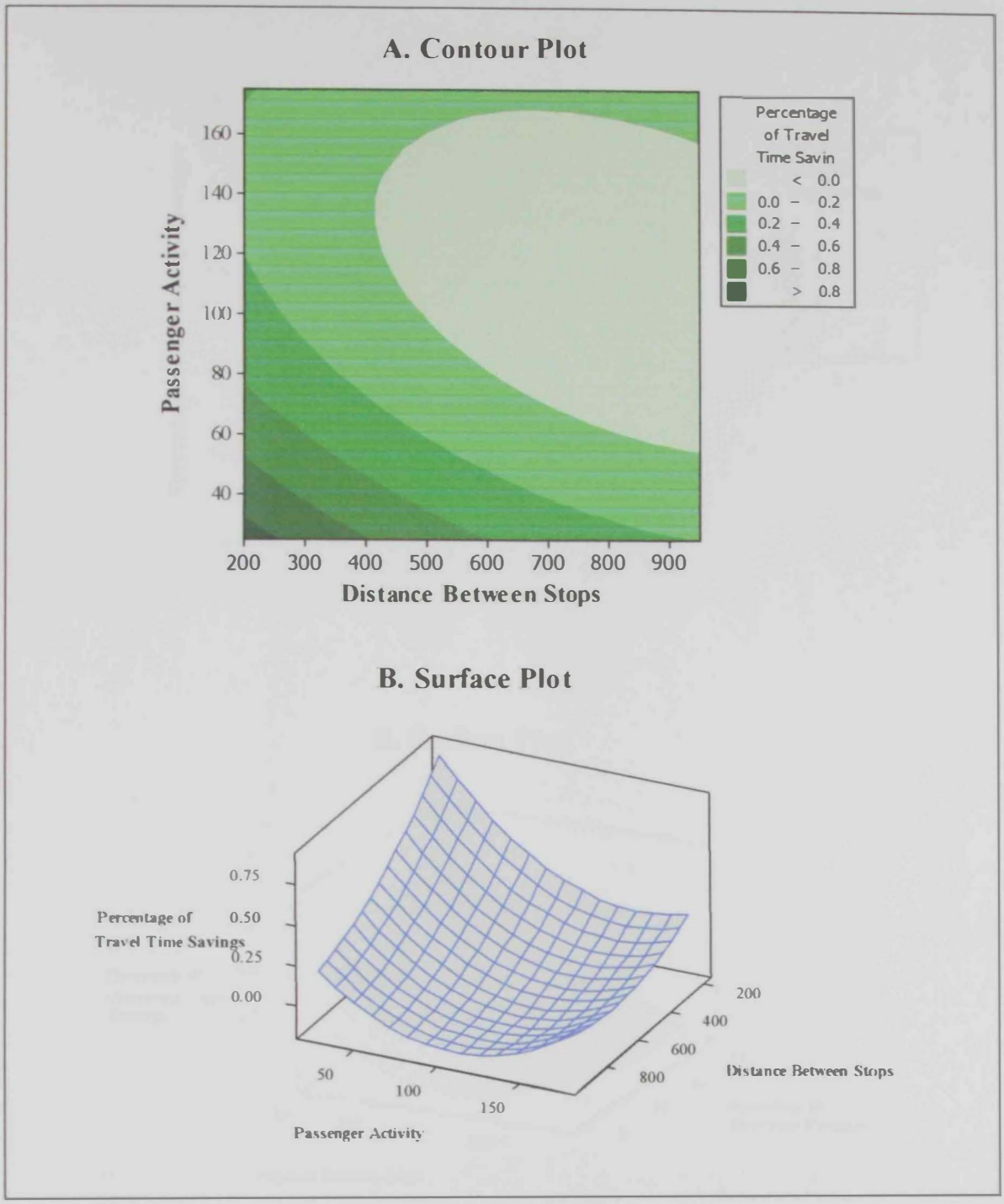


Figure 4.10: The *Percentage of Travel Time Savings* versus *Distance between Stops* and *Passengers' Activity*

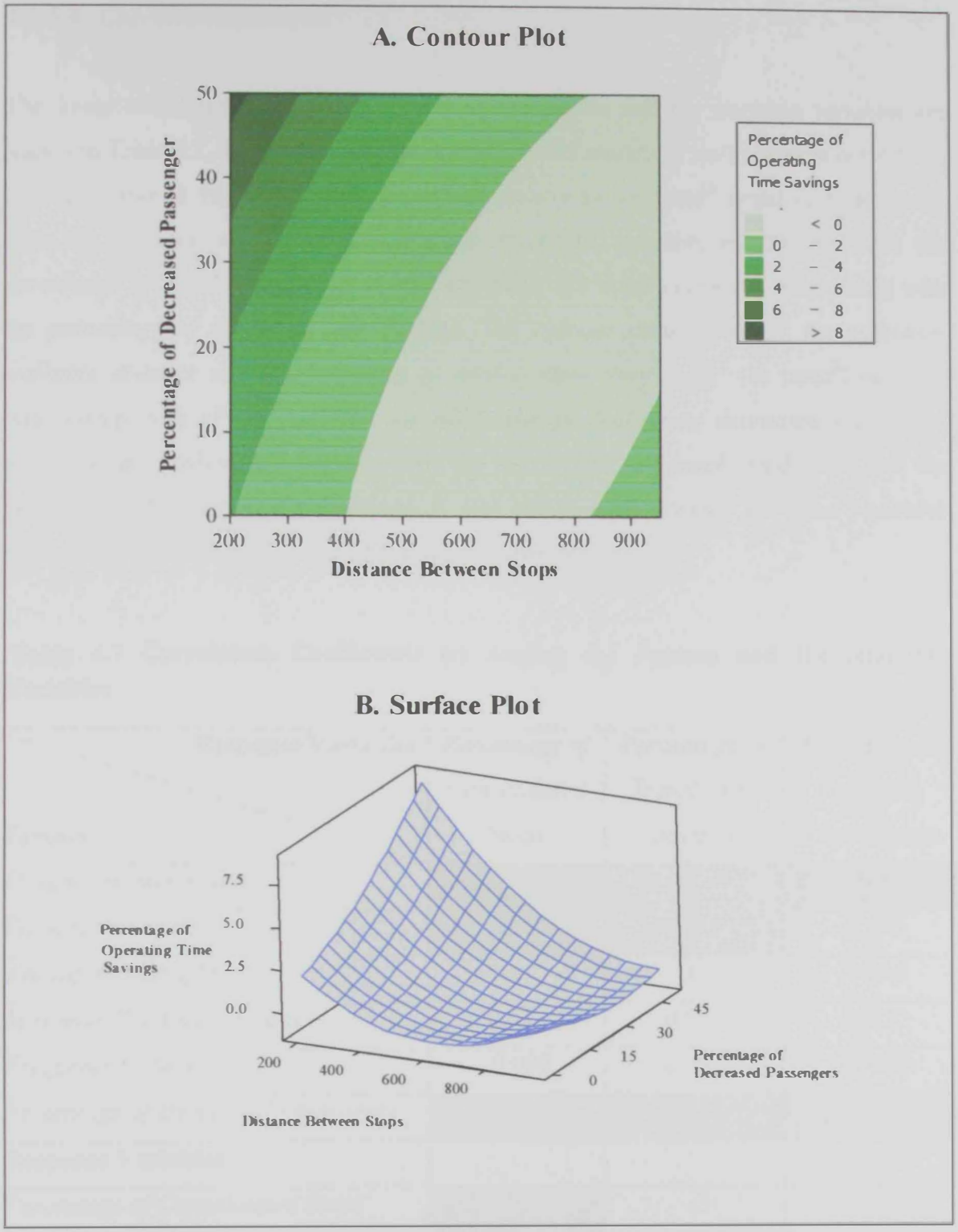


Figure 4.11: The *Percentage of Operating Time Savings* versus *Distance between Stops* and *Percentage of Decreased Passengers*

4.2.5.4 Correlation Analysis

The linear correlation coefficients (r) among the factors and the response variables are shown in Table 4.7. The *distance between stops* shows moderate[2] and negative correlation with all response variables. The *passengers' activity* shows weak[2] negative relationship with the *percentage of consolidated stops*, moderate[2] negative relationship with the *percentage of travel time savings* and a very weak[2] (or none[2]) negative relationship with the *percentage of operating time savings*. The *average cruising speed*, the *maximum walkable distance* and the *frequency of service* show very weak[2] (or none[2]) negative relationship with all the response variables. The *percentage of decreased passengers* shows weak[2] positive relationship with the *percentage of consolidated stops* and the *percentage of operating time savings*. It also shows a very weak[2] (or none[2]) positive relationship with the *percentage of travel time savings*.

Table 4.7 Correlation Coefficients (*r*) Among the Factors and the Response Variables

Response Variables / Factors	*Percentage of Consolidated Stops*	*Percentage of Travel Time Savings*	*Percentage of Operating Time Savings*
Distance Between Stops	-0.494	-0.345	-0.486
Passengers' activity	-0.235	-0.339	-0.090
Average Cruising Speed	-0.093	-0.003	-0.046
Maximum Walkable Distance	0.043	0.040	0.019
Frequency of Service	-0.090	0.082	-0.088
Percentage of Decreased Passengers	0.260	0.132	0.289
Response Variables			
Percentage of Consolidated Stops	1		
Percentage of Travel Time Savings	0.781	1	
Percentage of Operating Time Savings	0.933	0.678	1

Strength of Relationship *Strong* *Moderate* *Weak* *Very Weak/none*

[2] The scale of the "strength of relationship" is taken from Choudhury (2009). Four strength categories are taken; strong (r = -1.0 to -0.5 or 1.0 to 0.5), moderate (r = -0.5 to -0.3 or 0.3 to 0.5), weak (r = -0.3 to -0.1 or 0.1 to 0.3) and or very weak/none (r = -0.1 to 0.1)

In Table 4.7, the correlation among the three response variables are also provided. They show a strong[2] and positive relationship among them.

4.3 Discussions

4.3.1 Effect of the *Distance between Stops* factor

From the descriptive statistics, we concluded that the mean value of the different levels of the *distance between stops* varied clearly, and this suggested a relationship between this factor and the response variables. From the ANOVA tables (Table 4.4 to 4.6), a strong evidence existed as the Sum of Squares of the *distance between stops* showed a large share; 28.69%, 12.96% and 29.66% for the *percentage of consolidated stops*, *percentage of travel time savings* and *percentage of operating time savings* respectively. The main effect plots (Figure 4.5 to 4.7) also confirmed that this factor has a considerable effect on the three responses. Moreover, it indicated negative moderate relationships with all the responses. As a result, we can conclude that the *distance between stops* has considerable effect on all the three responses. Any of the response variables increases as the *distance between stops* is decreased.

The *percentage of consolidated stops* is more with lower *distance between stops*. This means that there is more chance or probability of stop consolidation at the lower levels of the *distance between stops* than at the higher levels. Savings in users travel time and operating time are also more if the *distance between stops* is low.

This study consolidates stop(s) according to the travel time savings of the users at a particular stop. If the stop spacing is high, the extra walking time of the affected passengers is likely to exceed the travel time savings of the through passengers. Moreover, for high stop spacing, the accessibility (maximum walkable distance) will likely decrease and this may decrease the chances of consolidation. Therefore, for low levels of *distance between stops*, the chances of consolidation are high.

4.3.2 Effect of the *Passengers' Activity* Factor

From the descriptive statistics, we concluded that the mean value of the different levels of the *passengers' activity* varied, but the variation was not constant. It was high at the lowest levels (between 0-50 and 50-100 passengers per hour), but very low variations were seen at the other higher levels. The ANOVA tables (Table 4.4 to 4.6) showed that the *passengers' activity* has a large share of Sum of Squares; 13.44% and 21.98% for the *percentage of consolidated stops* and the *percentage of travel time savings*, respectively. It has a small share (3.86%) for the *percentage of operating time savings*. The correlation table (Table 4.7) showed very weak relation between the *passengers' activity* and the two response variables of the *percentage of consolidated stop* and the *percentage of operating time savings* (the correlation coefficient of the *percentage of consolidated stops* is near to moderate strength). A relationship of moderate strength is evident with the *percentage of travel time savings*.

According to the above discussion we can conclude that the *passengers' activity* has considerable effect on the two response variable of the *percentage of travel time savings* and the *percentage of consolidated stops*. Although the *percentage of consolidated stops* showed weak relationship, the size of the Sum of Squares cannot be neglected. The main effect plots (Figure 4.5 and 4.6) showed that the *percentage of consolidated stops* and *percentage of travel time savings* are more for the level of 0-50 passengers per hour. These two responses decrease sharply when the *passengers' activity* are increased to the level of 50-100 passengers per hour. When the *passengers' activity* is increased more (100+ passengers per hour), the responses are slightly increased.

Passengers' activity is a function of the boarding and alighting passengers. In the model, the *travel time savings* depends mainly on the on-board passenger, which is a function of boarding-alighting or passengers' activity. Theoretically, the more the onboard passengers at a stop, the more the chance of getting positive travel time savings. Although the *passengers' activity* at a particular stop can indicate the increase or decrease of the on-board passengers at that stop, it cannot itself indicate the size of the actual on-board passenger. Detailed examination is required to understand the relationship between the *passengers' activity* and the response variables.

4.3.3 Effect of the *Percentage of Decreased Passengers* Factor

The descriptive statistics indicate that the mean value of different levels of the factor *percentage of decreased passengers* varied clearly within the *percentage of consolidated stops* and the *percentage of operating time savings*. The variation is not as much with the *percentage of travel time savings*. From the ANOVA tables (Table 4.4 to 4.6), the Sum of Squares of the factor shows good share of the *percentage of consolidated stops* (7.75%) and of the *percentage of operating time savings* (9.66%). It shows a low share of the *percentage of travel time savings* (2.03%). We can conclude that the *percentage of decreased passengers* has considerable effects on the *percentage of consolidated stops* and *percentage of operating time savings*.

The *percentage of consolidated stops* and the *percentage of operating time savings* are more when the *percentage of decreased passengers* is higher. There is more chance or probability of stop consolidation with higher values of *percentage of decreased passengers* than lower passenger loss. *Percentage of operating time savings* is also more if the *percentage of decreased passengers* is more.

In the theory of the model, if the passengers are decreased, the time loss due to walking and waiting will be lesser, compared to the case of no decrease in passengers. Therefore, the chance of travel time savings at the stop will be more, and this will eventually increase the chance of consolidation. Again, decreased passengers will result in decreasing the operating time, as the boarding-alighting time for those passengers will be zero.

4.3.4 Effects of Other Factors

The other three factors; *average cruising speed, maximum walkable distance and frequency of service* show very little effect on response variables as the Sum of Squares are very low (less than 2%), compared to the effects of the factors discussed in the previous three sections. Moreover, most of their interactions with the other factors also yield lower Sum of Squares.

Average cruising speed shows negative relationship with all the responses. The strengths of these relationships are very weak (or none). The only interaction of this factor with the *passengers' activity* has little effect on the *percentage of travel time savings* (the Sum of Squares is 2.16%).

Maximum walkable distance shows positive relationship with all the responses. Nonetheless, the strengths of these relationships are very weak (or none). As a result, this factor seems insignificant in the current experimental setting. In the model, the factor acts as a decision factor of consolidation; if the distances of any of the shed-lines of a stop are more than the *maximum walkable distance*, the stop cannot be consolidated. That is, the chance of consolidation should be higher at the high level than at the low level of the *maximum walkable distance*. In the current experimental setting, the distance of the shed-lines can be rarely higher than 600m, while the lowest level value for the *maximum walkable distance* is 600m. As a result, there is very little chance (very few scenarios) to observe its effect in the current experimental setting. A sensitivity test is performed in the case study (see section 5.3.6) to observe the effects of the *maximum walkable distance* on the response variables.

Frequency of service shows negative relationship with *percentage of consolidated stops* and *percentage of operating time savings*. It shows a positive relationship with the *percentage of travel time savings*. The strength of these relationships is very weak (or none). The *Frequency of service* is used to calculate two values; headway (which is used to calculate waiting time) and the trip-wise passengers' activity. As the waiting time has no relationship with the operating time calculation or the user travel time savings (which is used in stop consolidation), the very weak relationship of *frequency of service* with these two responses is logical. The interaction of *frequency of service* with the *passengers' activity* yields some impacts on the *percentage of travel time savings* (the sum of squares is 4.66%). This happens because the *frequency of service* eventually decreases the trip wise *passengers' activity*, which has moderate effect on *percentage of travel time savings*.

4.3.5 Effect of Interactions

Significant interactions are presented in section 4.2.5.3. The most important interaction is seen between the *distance between stops* and the *percentage of decreased passengers* for the response variables the *percentage of operating time savings* and the *percentage of consolidated stops*. In general, the *percentage of operating time savings* and the *percentage of consolidated stops* are more when the *percentage of decreased passengers* is more and the distance between stops is less.

Other important interaction is observed between the *distance between stops* and the *passengers' activity* for the response variables *percentage of travel time savings* and *percentage of consolidated stops*. In general, the *percentage of travel time savings* and the *percentage of consolidated stops* are more when the level of *passengers' activity* and the *distance between stops* is low. The *percentage of travel time savings* and the *percentage of consolidated stops* are less when the *distance between stops* and the *passengers' activity* is high. In a setting of moderate *passengers' activity* and low *distance between stops*, the *percentage of consolidated stops* is moderate. For a high level of *passengers' activity* and low *distance between stops*, the *percentage of stop consolidation* is high.

4.3.6 Summary of Discussion

The discussions in the previous sections (section 4.3.1 to 4.3.5) are summarized in the Table 4.8 to show the importance of the factors according to the response variables. The assessment is done based on the percentage of Sum of Squares (SS) in ANOVA test (main effects and interaction effects) and the strength of the correlation. The main and interaction effects (examined in the ANOVA test) are assessed as very high (SS is more than 20%), high (SS is 15-20%), moderate (SS is 10-15%), minor (SS is 5-10%) and negligible (SS is less than 5%). The interaction of each factor (with another factor) is examined and the best (highest percentage of SS) effect is chosen for the assessment. The strength of correlation is taken from Table 4.7, which is assessed according to Choudhury[2] (2009). Importance of the factor is determined as very important (any of the effects is high/very high or strength of correlation is moderate/high), not important (all

the effects are negligible and strength of correlation is weak/very weak) and important (all the other scenarios).

From Table 4.8, we conclude that three factors are showing considerable effects on the response outputs/variables. These are *distance between stops, passengers' activity* and *percentage of decreased passengers*. Among these, the effects of *passengers' activity* cannot be explained properly, it needs more study. The other three factors and some of their interactions show some effects, but are not or less significant. The *maximum walkable distance* does not show the effect properly in the current experimental setting, though it shows significant effect on the response variables in a sensitivity test (see section 5.3.6).

Table 4.8 Summary of the Factorial Experiment Results

Response Variables	Factors	Effects observed from ANOVA*		Strength of Correlation**	Importance***
		Main Effect	Interaction Effects		
Percentage of Consolidated Stops	*Distance Between Stops*	Very High	Moderate	Moderate	Very important
	Passengers' activity	Moderate	Minor	Weak	Important
	Average Cruising Speed	Negligible	Negligible	Very Weak	Not important
	Maximum Walkable Distance	Negligible	Negligible	Very Weak	Not important[3]
	Frequency of Service	Negligible	Negligible	Very Weak	Not important
	Percentage of Decreased Passengers	Minor	Moderate	Weak	Important
Percentage of Travel Time Savings	*Distance Between Stops*	Moderate	Minor	Moderate	Very important
	Passengers' activity	Very High	Minor	Moderate	Very Important
	Average Cruising Speed	Negligible	Negligible	Very Weak	Not important
	Maximum Walkable Distance	Negligible	Negligible	Very Weak	Not important[3]
	Frequency of Service	Negligible	Negligible	Very Weak	Not important
	Percentage of Decreased Passengers	Negligible	Negligible	Weak	Not Important
Percentage of Operating Time Savings	*Distance Between Stops*	High	High	Moderate	Very important
	Passengers' activity	Negligible	Negligible	Very Weak	Not important
	Average Cruising Speed	Negligible	Negligible	Very Weak	Not important
	Maximum Walkable Distance	Negligible	Negligible	Very Weak	Not important[3]
	Frequency of Service	Negligible	Negligible	Very Weak	Not important
	Percentage of Decreased Passengers	Moderate	High	Weak	Very important

* Very High (SS is more than 20%), High (SS is 15-20%), Moderate (SS is 10-15%), Minor (SS is 5-10%), Negligible (SS is less than 5%)

** Strong (r = -1.0 to -0.5 or 1.0 to 0.5), Moderate (r = -0.5 to -0.3 or 0.3 to 0.5), Weak (r = -0.3 to -0.1 or 0.1 to 0.3) and Very Weak/None (r = -0.1 to 0.1)

*** Very Important (any of the effects is high/very high or strength of correlation is moderate/high), Not Important (all the effects are negligible and strength of correlation is weak/very weak) and Important (all the other scenarios)

[3] Does not show the effect properly in the current experimental setting, though it shows significant effect on the response variables in a sensitivity test (see section 5.3.6)

Chapter 5

CASE STUDY

A case study was conducted to assess the model validity in a real life situation. Two bus routes from Al Ain public bus service were selected. The service is provided by Department of Transport (DoT), the government authority responsible for transport planning and policy in the Emirates of Abu Dhabi.

5.1 Route Description

There are eight operating routes in Al Ain. Among these, route 900 and 930 were chosen for the study. Route 900 starts from Bawadi Mall and ends at Hili Park (See Figure 5.1). This route has 52 stops towards Hili Park and 46 stops towards Bawadi Mall. The route is about 29.7 kilometers long and has 11 transfer stops (7 towards Bawadi Mall and 4 towards Hili Park). This route connects two sub-urban regions (Mezyad and Hili) through the Town Center.

Route 930 starts from Al Fo'a Mall and ends at Al Bateen (See Figure 5.1). This route has 60 stops towards Al Bateen and 66 stops towards Al Fo'a Mall. The route is about 44.8 kilometers long and has 15 transfer stops (5 towards Al Fo'a Mall and 10 towards Al Bateen). This route is also connects two sub-urban regions (Al Bateen-Maqam and Al Fo'a) through the Town Center.

5.2 Data Collection

Data were collected through a comprehensive study conducted on the year 2009 by Roadway, Transportation and Traffic Safety Research Center (RTTSRC) of the United Arab Emirates University (UAEU). This study aimed at assessing of public bus operation and services in the Emirate of Abu Dhabi (RTTSRC, 2009). In this study, bus routes of

Abu Dhabi and Al Ain were evaluated. The data used in this research thesis was obtained and processed from the above mentioned study.

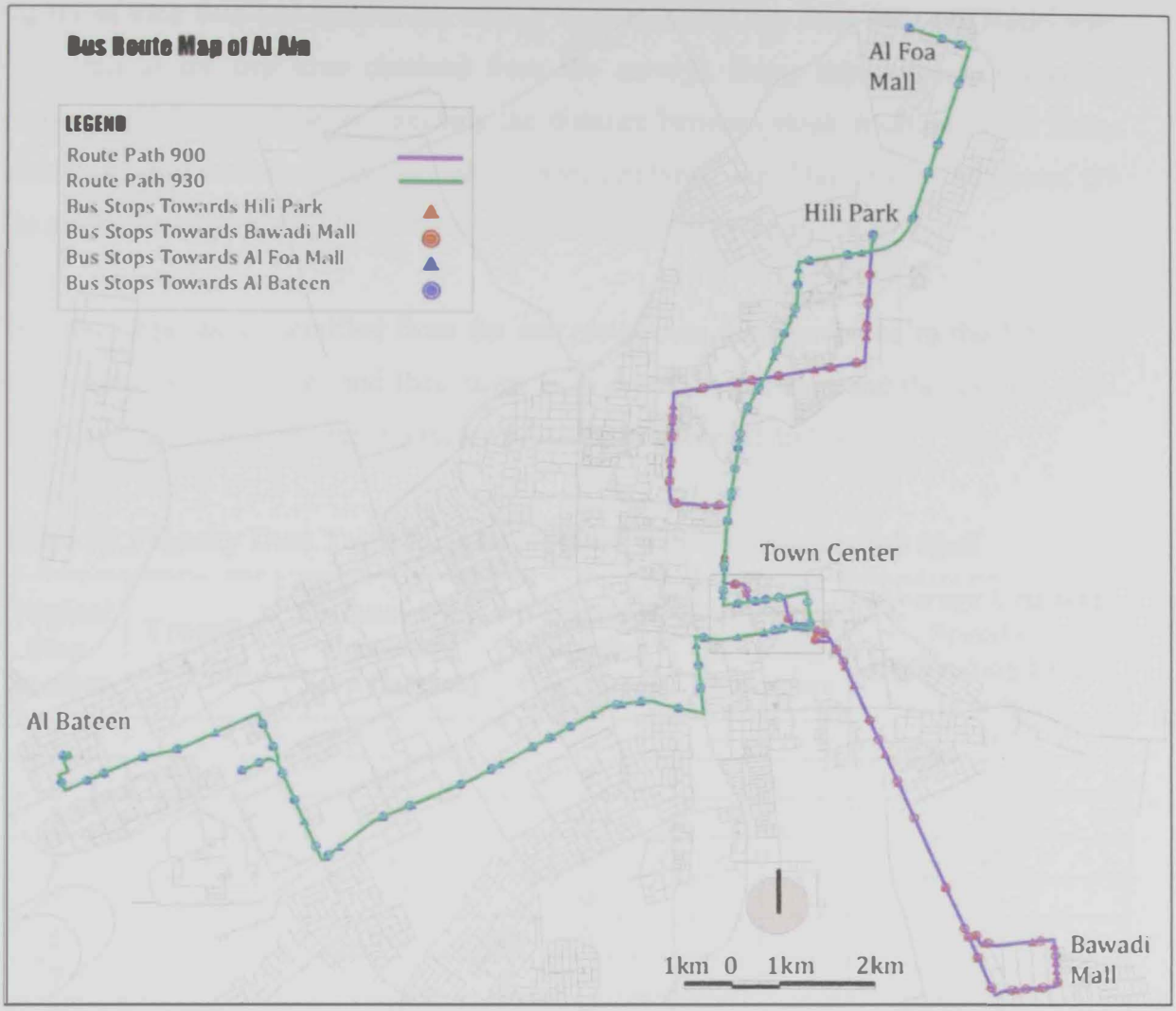


Figure 5.1: Case Study Bus Route Map of Al Ain

In that study (RTTSRC, 2009); each route was surveyed seven days a week at three peak hours and for both directions. That is, 21 peak hours were surveyed for each route direction throughout the week. The routes were surveyed in a staggered way (within the peak hour) in order to investigates the bus trips at various times (e.g. 7 AM, 7:30, 8:00, 8:30, etc). This was done to ensure the representation of entire peak-time period. These surveys contain location (GPS coordinates) and loading (alighting and boarding) information of stops. They also recorded the travel time between each stop. For the case study, only one survey, in each direction of routes 900 and 930, with an average loading pattern was selected.

The surveys collected travel times between stops in minutes, which are used to calculate the average cruising speeds. As more accurate travel time (in seconds) was not available, this data needed to be adjusted. Initially, the average cruising speeds were calculated from the travel time data and used in the model. The calculated trip time from the model was compared to the trip time obtained from the surveys. Some adjustments in average cruising speed were done by checking the distance between stops, location of the links, number of intersections along the link, intersection types, etc. This process continued till the model's estimated trip-times became close to the survey's trip times.

Transfer stops were identified from the complete route maps prepared in the RTTSRC study. Here, all the routes and their stops were drawn in one map and the transfer stops were identified. Finalized input data are provided in Table 5.1 to 5.4.

Table 5.1 Primary Data Table for Al Ain Route 900, towards Bawadi Mall

Original Stop Number	Transfer Station	Distance from Preceding Stop (meters)	Number of Alighting Passengers	Number of Boarding Passengers	Average Cruising Speed on Preceding Link (km/hr)
1	1	0	0	0	0
2	0	885	0	0	38
3	0	673	0	0	38
4	0	547	0	0	41
5	0	917	0	1	45
6	0	612	0	1	40
7	0	1157	0	4	42
8	0	610	0	0	44
9	0	1069	0	2	39
10	0	1220	0	2	36
11	0	398	0	1	44
12	0	560	0	1	45
13	0	455	0	1	39
14	0	647	0	0	37
15	0	964	0	0	35
16	1	565	0	0	38
17	1	964	0	0	42
18	1	678	0	0	10
19	0	341	0	0	11
20	1	402	3	2	20
21	0	229	1	1	11
22	0	296	2	0	16

23	0	599	0	0	15
24	1	459	0	0	20
25	0	359	3	14	16
26	0	161	3	0	18
27	1	584	0	9	15
28	0	579	0	1	14
29	0	301	0	0	19
30	0	1432	0	0	31
31	0	476	0	3	29
32	0	1004	0	12	42
33	0	917	0	0	43
34	0	1716	1	0	35
35	0	995	7	0	44
36	0	204	0	0	44
37	0	497	0	0	41
38	0	763	0	0	36
39	0	557	16	0	26
40	0	314	1	1	30
41	0	410	2	0	26
42	0	401	9	0	21
43	0	581	0	0	29
44	0	641	0	0	28
45	0	1189	8	0	40
46	1	367	0	0	28

Table 5.2 Primary Data Table for Al Ain Route 900, towards Hili Park

Original Stop Number	Transfer Station	Distance from Preceding Stop (meters)	Number of Alighting Passengers	Number of Boarding Passengers	Average Cruising Speed on Preceding Link (km/hr)
1	1	0	0	0	0
2	0	296	0	0	21
3	0	1065	0	0	29
4	0	608	0	0	22
5	0	373	0	2	20
6	0	196	1	0	21
7	0	233	0	2	29
8	0	523	0	0	25
9	0	515	0	0	24
10	0	707	1	5	27
11	0	682	0	2	39
12	0	507	0	11	44
13	0	1223	0	1	40
14	0	2540	0	4	39

15	0	711	0	3	35
16	0	861	0	2	38
17	0	805	0	1	42
18	0	468	0	4	35
19	0	428	0	0	15
20	1	589	0	0	14
21	0	570	0	1	17
22	0	185	0	2	17
23	0	270	0	0	20
24	1	166	0	0	13
25	0	391	0	2	12
26	0	917	0	0	19
27	1	198	0	0	15
28	0	359	3	0	19
29	0	435	2	0	18
30	1	604	2	0	34
31	0	267	0	0	35
32	0	772	9	5	28
33	0	597	2	2	32
34	0	288	1	3	32
35	0	620	1	0	30
36	0	673	1	0	44
37	0	375	2	0	37
38	0	602	4	0	40
39	0	360	5	0	41
40	0	343	2	0	39
41	0	866	1	0	39
42	0	853	1	0	40
43	0	332	1	0	37
44	0	608	2	0	43
45	0	795	1	0	38
46	0	398	3	0	40
47	0	562	0	0	44
48	0	731	2	0	41
49	0	349	1	0	39
50	0	518	0	0	39
51	0	576	0	0	39
52	1	924	4	0	38

Table 5.3 Primary Data Table for Al Ain Route 930, towards Al Bateen

Original Stop Number	Transfer Station	Distance from Preceding Stop (meters)	Number of Alighting Passengers	Number of Boarding Passengers	Average Cruising Speed on Preceding Link (km/hr)
1	1	0	0	13	0
2	0	776	0	1	50
3	0	467	0	1	42
4	0	1069	0	4	48
5	0	1460	0	0	42
6	0	632	0	0	50
7	0	1118	0	2	40
8	1	1711	0	1	36
9	0	1011	0	1	50
10	0	861	0	0	50
11	0	729	0	0	40
12	0	566	0	1	38
13	0	623	0	0	41
14	0	393	0	3	44
15	1	909	0	0	45
16	0	520	0	1	36
17	0	613	0	4	37
18	0	330	0	2	43
19	0	465	0	2	39
20	0	550	0	1	32
21	1	636	0	0	27
22	1	978	2	0	25
23	1	563	0	0	30
24	0	694	5	2	25
25	0	391	0	1	20
26	1	233	0	4	24
27	0	298	3	1	19
28	0	826	1	0	24
29	0	481	30	6	15
30	1	299	0	3	19
31	0	187	0	1	13
32	0	277	0	0	12
33	1	212	0	1	14
34	0	1598	1	0	44
35	0	845	2	0	38
36	0	502	1	0	37
37	0	1157	0	0	38
38	0	827	0	0	45
39	1	571	1	1	38
40	0	1127	0	1	43

41	0	624	0	0	43
42	0	407	0	0	35
43	0	1036	0	0	42
44	0	760	1	0	39
45	0	1225	0	0	39
46	0	628	1	0	40
47	0	1495	2	0	36
48	0	501	1	0	42
49	0	1128	2	0	45
50	0	632	0	0	43
51	1	708	1	0	20
52	0	420	1	0	25
53	0	1247	0	0	19
54	0	542	0	1	40
55	0	2221	0	0	38
56	0	764	2	0	43
57	0	937	0	0	43
58	0	398	0	0	39
59	0	724	0	0	42
60	1	1041	2	0	41

Table 5.4 Primary Data Table for Al Ain Route 930, towards Al Fo'a Mall

Original Stop Number	Transfer Station	Distance from Preceding Stop (meters)	Number of Alighting Passengers	Number of Boarding Passengers	Average Cruising Speed on Preceding Link (km/hr)
1	1	0	0	1	0
2	0	1014	0	0	35
3	0	805	0	2	43
4	0	393	0	0	37
5	0	948	0	0	37
6	0	755	0	0	37
7	0	914	0	0	40
8	0	1281	0	1	43
9	0	565	0	0	40
10	0	829	0	3	19
11	0	414	0	3	18
12	0	1072	2	0	23
13	0	674	0	0	40
14	0	534	0	0	42
15	0	1070	0	0	41
16	0	369	0	0	37
17	0	1160	0	3	36

18	0	705	0	0	42
19	0	1154	0	0	41
20	0	732	0	0	36
21	0	288	0	0	43
22	0	781	0	0	42
23	0	491	0	0	40
24	0	465	0	1	38
25	1	571	0	1	43
26	0	681	1	3	39
27	0	433	0	0	44
28	0	864	0	0	36
29	0	1110	1	0	43
30	0	608	1	0	40
31	0	375	3	3	45
32	0	394	0	1	40
33	0	740	0	2	45
34	1	600	2	2	12
35	0	249	0	0	19
36	0	166	0	4	14
37	0	298	1	0	19
38	1	156	0	1	13
39	1	357	6	14	20
40	0	1605	1	1	24
41	0	203	0	0	16
42	0	425	0	0	19
43	0	544	0	1	23
44	1	634	1	4	37
45	0	1046	0	0	42
46	0	549	0	0	42
47	0	1117	1	0	40
48	0	196	5	4	48
49	0	678	3	0	47
50	0	463	2	0	40
51	0	848	2	0	35
52	0	597	4	0	44
53	0	451	1	0	49
54	0	737	2	0	36
55	0	301	0	0	36
56	0	394	0	0	38
57	0	864	0	0	38
58	0	286	0	0	36
59	0	681	1	0	37
60	0	1841	5	0	47
61	0	946	0	0	43

62	0	798	1	0	38
63	0	1477	0	0	43
64	0	982	4	0	43
65	0	398	0	0	38
66	1	739	5	0	43

5.3 Data Analysis

5.3.1 Model Parameters and Assumptions

Detailed model outputs of the case study are provided in Annexure 2. The parameters and assumptions used in these analyses are given below. *Maximum walkable distance* is set as 800 meters, obtained from a survey conducted in Dubai (Hassan et al., 2010 and Ahmed et al., 2011) which has similar environmental condition like Al Ain. *Frequency of service* is 4 per hour obtained from the RTTSRC (2009) study. *Percentage of decreased passengers* is taken as zero (0%). As there is no other public bus transportation in Al Ain and the other alternative (taxi) is a bit more expensive, users are expected to use the bus service even if stops are to be consolidated. The assumptions are similar to these discussed in Chapter 3.

Parameters

1. *Maximum Walkable Distance*: **800 meter**
2. *Frequency of Service*: **4 per hour**
3. *Percentage of Decreased Passengers*: **0 %**

Assumptions

1. Acceleration Rate = **0.5 m/s^2**
2. Deceleration Rate = **2 m/s^2**
3. Walking Speed = **5 kilometers/hour**
4. Disutility = **0.4**
5. Door Open-Close Time at Each Stop = **5 seconds**
6. Boarding Time per Passenger = **3.5 seconds**
7. Alighting Time per Passenger = **1 second**

5.3.2 Model Summary

The summary of the model results is given in Table 5.5. It shows that a total of 30 stops (12 towards Bawadi Mall and 18 towards Hili Park) can be consolidated along route 900. This represents about 35.7% of the total eligible stops for consolidation. About 3.19% of the users travel time can be saved towards Bawadi Mall direction (62.5 minutes out of 1959 minutes of the initial users' travel time), and 5.3% towards Hili Park direction. The operating time saving is 3.54% (2.75 minutes savings from an initial operating time of 77.6 minutes) towards Bawadi Mall direction and 5.62% towards Hili Park direction.

On route 930, a total of 36 stops (14 towards Al Bateen and 22 towards Al Fo'a Mall) can be consolidated. This represents about 33.6% of the total eligible stops for consolidation. About 4.19% of the users travel time can be saved towards Al Bateen direction, and savings is 5.72% towards Al Fo'a Mall direction. The operating time saving is 3.81% towards Al Bateen direction and 6.22% towards Al Fo'a Mall direction.

Table 5.5 Summary Table of Case Study

	Route 900		Route 930	
	To Bawadi Mall	To Hili Park	To Al Bateen	To Al Fo'a
Total Number of Stops	46	52	60	66
Total Number of Eligible Stops for Consolidation	38	46	48	59
Total Number of Consolidated Stops	12	18	14	22
Percentage of Consolidated Stops (%)	31.6	39.1	29.2	37.29
Initial Users' Travel Time (minutes)	1959	2258	2400	2174
Users' Travel Time Savings (minutes)	62.5	119.6	100.5	124.3
Users' Travel Time Savings (%)	3.19	5.3	4.19	5.72
Initial Operating Time (minutes)	77.6	77.7	98.6	100.8
Operating Time Savings (minutes)	2.75	4.37	3.76	6.27
Operating Time Savings (%)	3.54	5.62	3.81	6.22

5.3.3 Locational Analysis

The locations of consolidated stops are shown in Figure 5.2 to 5.5. These figures also show the position of remaining stops. In Town Center area, the percentage of consolidation is relatively high. Towards Bawadi Mall direction, out of the 12 stops in this area (among them 3 are transfer stops), 5 stops are consolidated (56%). Towards the Hili Park direction, the consolidation in Town Center area is about this is 70%, towards Al Bateen is 57% and towards Al Fo'a Mall is 60%. This may be attributed to the lower stop spacing in Town Center area compared to the other areas. This finding is similar to the findings of Wirasinghe and Ghoneim (1981), Furth and Rahbee (2000), Saka (2001) and Murray (2001).

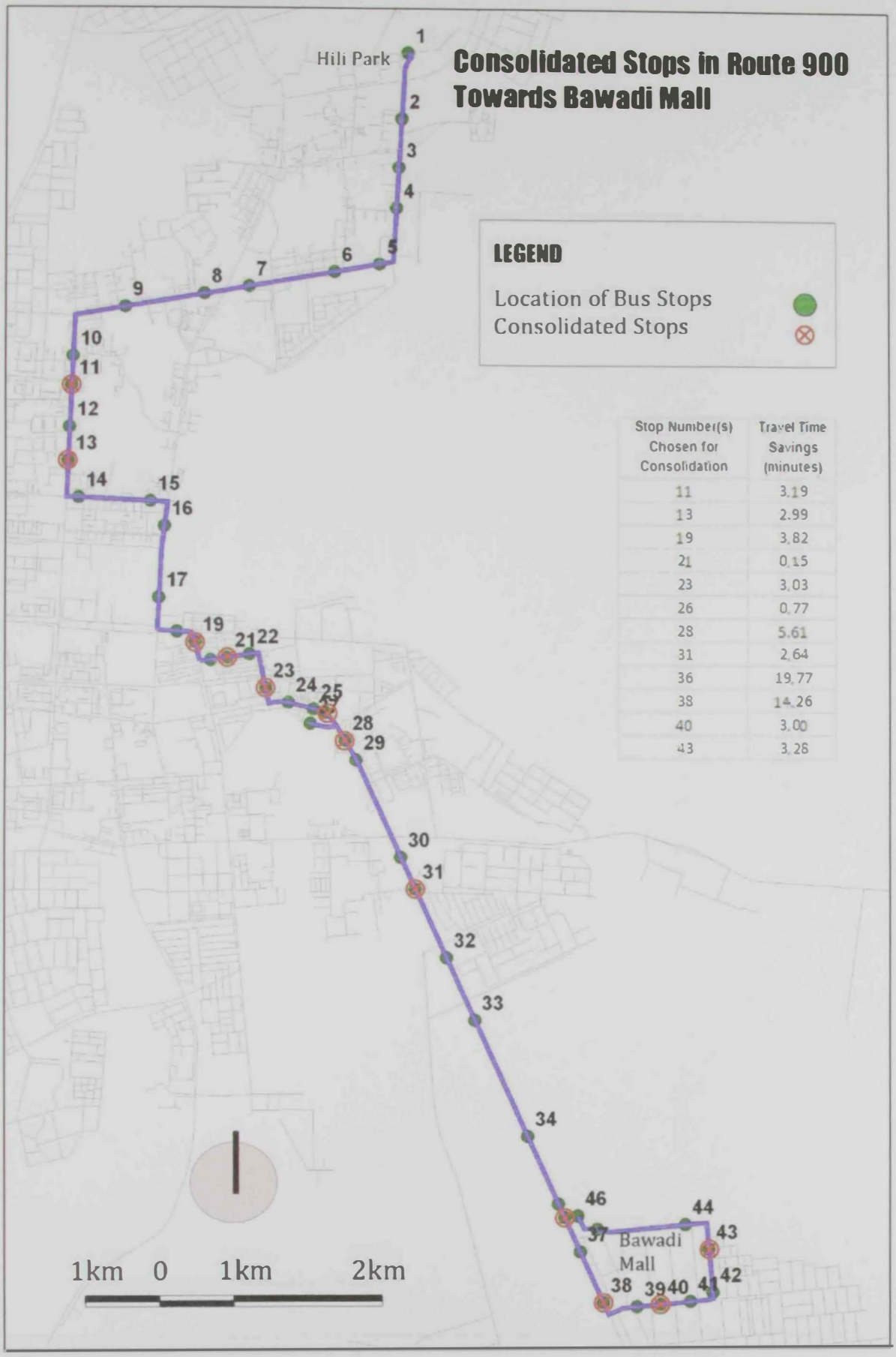


Figure 5.2: Consolidated Stops on Route 900 towards Bawadi Mall

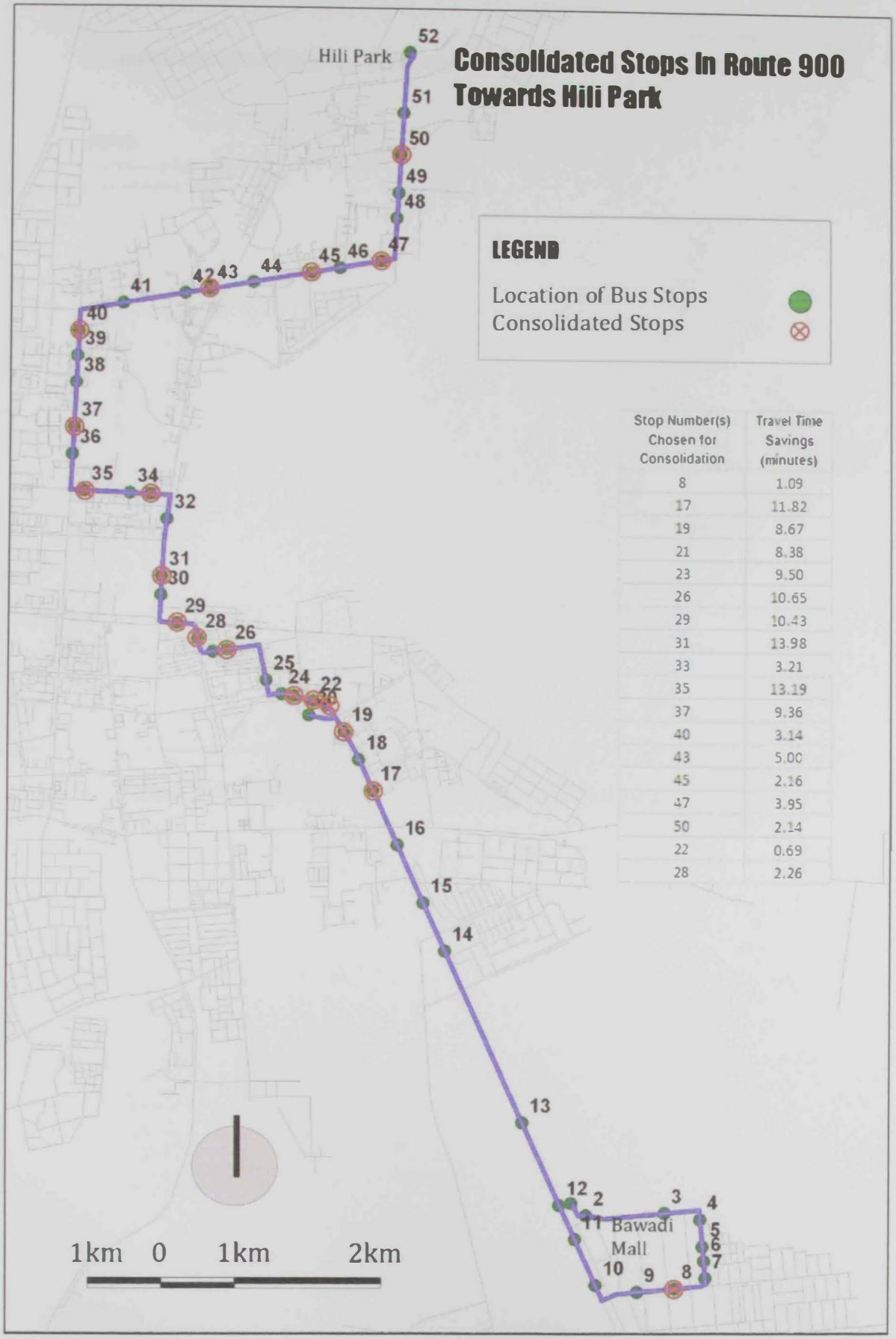


Figure 5.3: Consolidated Stops on Route 900 towards Hili Park

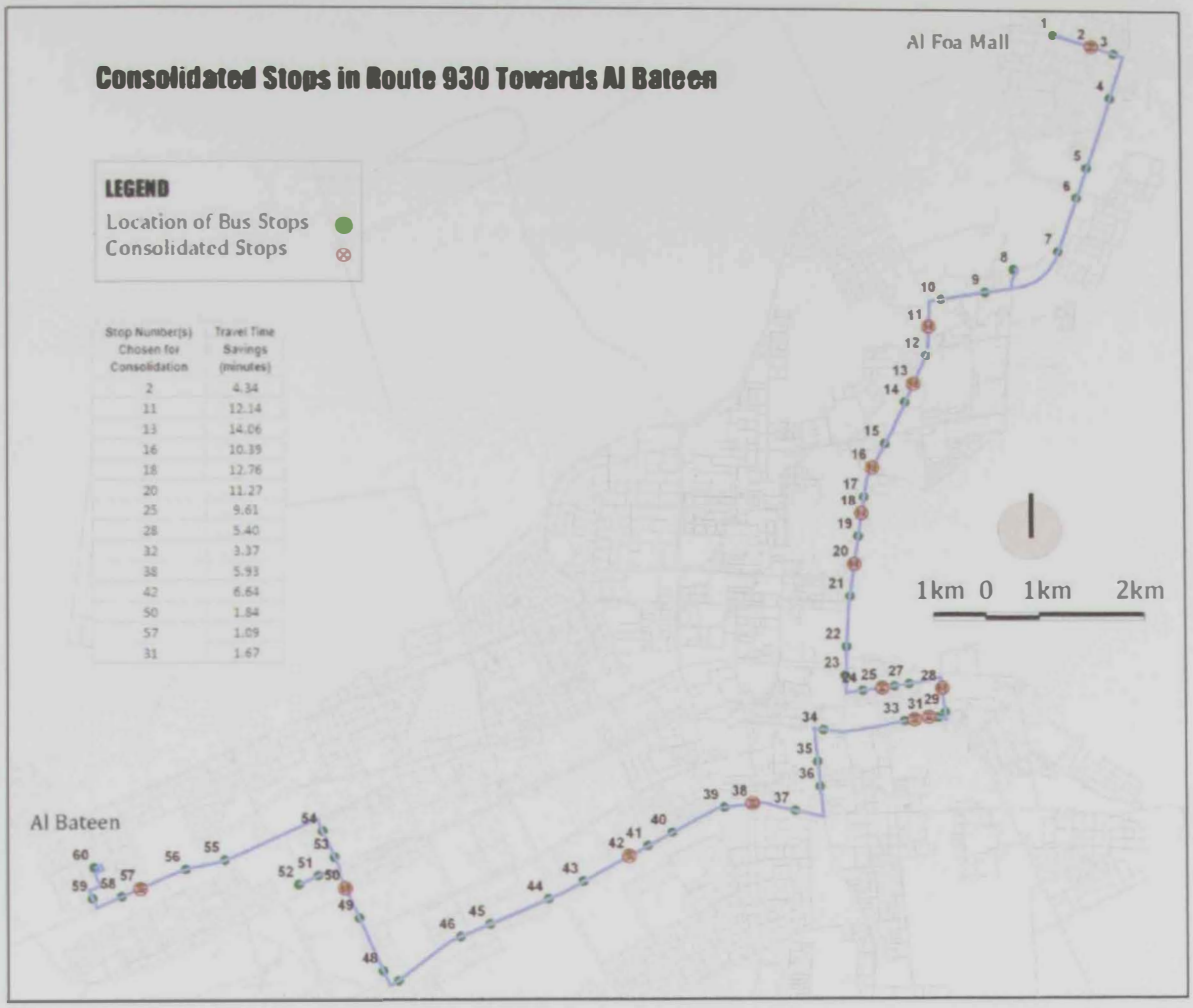


Figure 5.4: Consolidated Stops on Route 930 towards Al Bateen

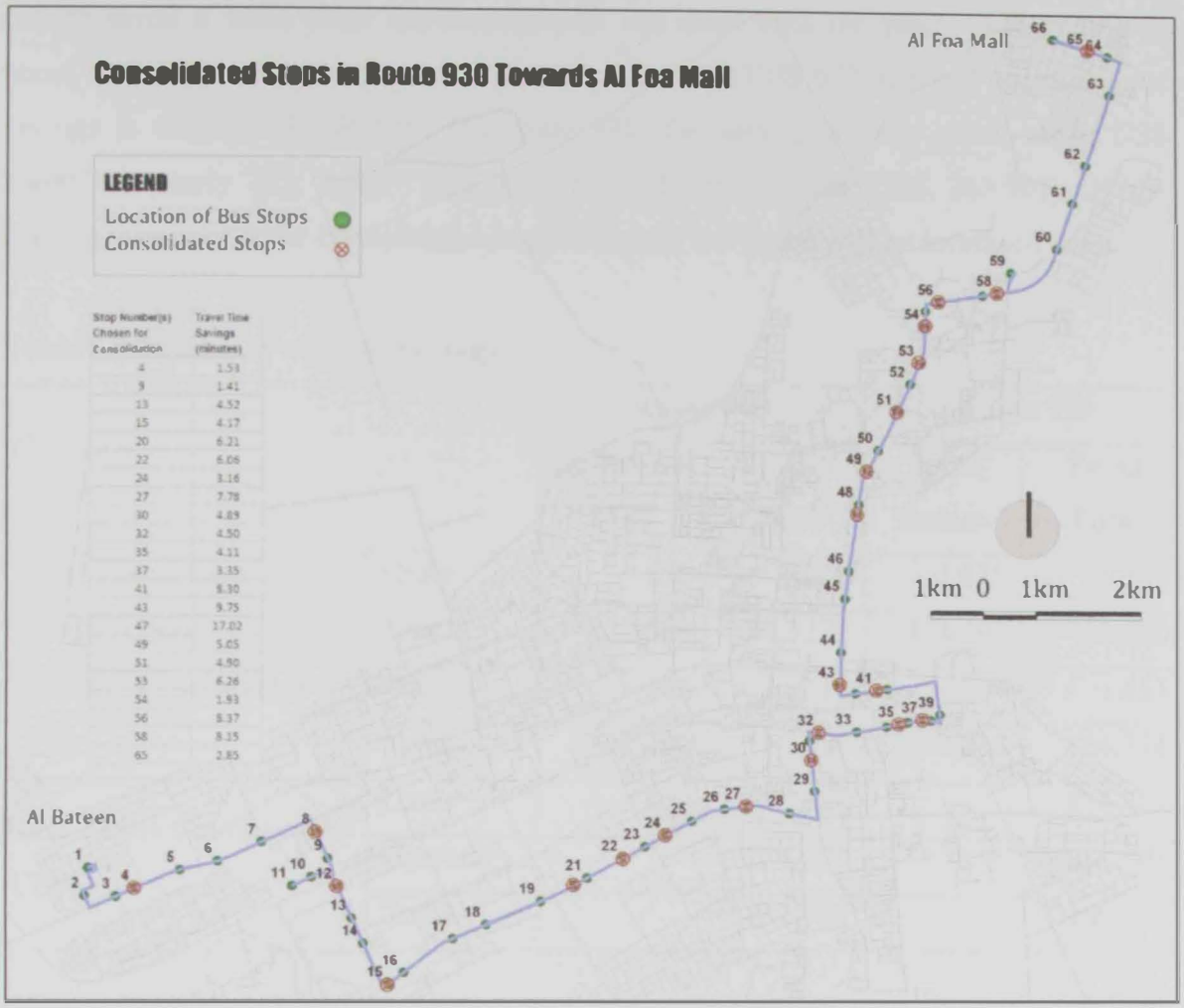


Figure 5.5: Consolidated Stops on Route 930 towards Al Fo'a Mall

5.3.4 Change in Distance

The average distance between stops is increased. Towards Bawadi Mall, the average distance between stops was initially about 645 m, which is increased to 873 m after the consolidation. It is increased to 877 m from 574 m towards Hili Park, 749 m, to 977 m towards Al Bateen, and 679 m to 1018 m towards Al Fo'a mall.

5.3.5 Value of Savings

The value of savings after the consolidation are estimated and presented in table 5.6. Here, the users' travel costs are assumed to be US$ 8.5 per hour (Hess et al., 2004). Operating cost per vehicle hour is assumed as US$ 60 according to Bertini and El-Geneidy (2004). Table 5.6 shows that considerable amount of users' and operators cost

can be saved if these stops are consolidated. For route 900, the yearly cost savings is about US$ 864,908, where users' cost savings is about US$ 677,958 and operators cost savings is about US$ 186,950. For route 930, the saving is even more; about US$ 1,100,282 yearly (for users' US$ 836,781 and for operator US$ 263,501). If the maintenance cost of the consolidated stops included, the figure will be increased more.

Table 5.6 Summary of Cost Savings

		Route 900		Route 930	
		To Bawadi Mall	To Hili Park	To Al Bateen	To Al Fo'a
Users' Travel Cost Savings (US$)	Daily	638	1,220	1,025	1,267
	Yearly	232,688	44,5271	374,162	462,620
Operating Cost Savings (US$)	Daily	198	314	270	451
	Yearly	72,192	114,758	98,725	164,776
Total Yearly Cost Savings (US$)	Users'		677,958		836,781
	Operator		186,950		263,501
	Total		864,908		1,100,282

5.3.6 Sensitivity with Maximum Walkable Distance

As discussed earlier in section 4.3.4, a test is performed to check the sensitivity of *maximum walkable distance* (or willingness to walk). Here, the model is run with three levels of *maximum walkable distance* (600, 800 and 1000 m). The results are shown in Table 5.7. The *number of consolidated stops* is increased significantly with the increase of *maximum walkable distance*. Savings in users' travel time and operating times are increased significantly as well. So, *maximum walkable distance* has significant influence on the response variables.

Table 5.7 Sensitivity of the Outputs with Maximum Walking Distance

Route	Directions	Outputs	Maximum Walking Distance		
			600 m	800 m	1000 m
900	Towards Bawadi Mall	Total Number of Consolidated Stops	8	12	14
		Users' Travel Time Savings (%)	2.01	3.19	4.05
		Operating Time Savings (%)	2.25	3.54	4.55
	Towards Hili Park	Total Number of Consolidated Stops	11	18	20
		Users' Travel Time Savings (%)	3.38	5.3	5.46
		Operating Time Savings (%)	3.29	5.62	6.34
930	Towards Al Bateen	Total Number of Consolidated Stops	7	14	23
		Users' Travel Time Savings (%)	2.12	4.19	5.76
		Operating Time Savings (%)	1.77	3.81	6.49
	Towards Al Fo'a Mall	Total Number of Consolidated Stops	9	22	27
		Users' Travel Time Savings (%)	2.35	5.72	7.48
		Operating Time Savings (%)	2.45	6.22	7.79

Chapter 6

CONCLUSIONS

6.1 Characteristics of the Model

The study presented a mathematical model and a program that enable decision making on consolidating transit stops according to the users' benefit. One of the important bases of stop consolidation decision making is the users' travel time savings. The model iterates until users' benefit (travel time savings) is maximized. Throughout the case study on two routes in Al Ain City bus service, the study showed that the users can benefit by stop consolidation. On route 900, about 182.1 (62.5 minutes in one direction and 119.6 minutes in the other direction) minutes of users' travel time can be saved each trip, which can save US$ 1858 daily (US$ 677,958 per year). On route 930, US$ 836,781 per year can be saved.

This model retains the concept of accessibility as it works for the benefit of the users. Although the distance between stops is increased after stop consolidation, still these are within the accessible distance. It considers the user's perception of accessibility by users' willingness to walk for the bus service (maximum walkable distance). As willingness to walk varies from place to place, the model is designed to cope with this situation.

This model used users' willingness to walk to determine the maximum walkable distance, which is the most influential parameter of demand change. Thus, it is expected that the demand change will be very minimum or negligible. Although this model incorporates this demand change (if any) by taking inputs (*percentage of decreased passengers*) from the users through a user survey. To estimate the *percentage of decreased passengers*, one can run the model to determine the consolidated stops assuming no demand change, then conduct user surveys at the chosen stops (for consolidation) to know the percentages of the decreased passengers and use these values to re-analyze the route. The *percentage of*

decreased passengers can also be estimated using some appropriate mode split model to capture the effect of stop consolidation on ridership.

Another important feature of the model is its ability to demonstrate how much trip/operating time can be saved after consolidation. This is a very important issue for the agency as they intend to maximize profit, without hampering the ridership. This model shows very good reduction in trip time. On route 900, towards Bawadi Mall, 2.75 minutes (3.54%) trip time is reduced after consolidation. Along the other direction of route 900 (towards Hili Park), the reduction is even more (4.37 minutes, 5.62%). On route 930, about 6.27 minutes (6.22%) can be reduced by this model. This reduction in travel time saves US$ 186,950 per year, on route 900, and US$ 263,501 per year on route 930.
The model is formulated by calculating the direct impacts of stop consolidation on users travel time savings. Users initial travel times and operating times are also calculated directly. As a result, this model is free from probable complications (which are common to indirect formulations, for example, comparing from a base case scenario).

This model uses a combinatorial procedure to assess the various consolidation decisions. It analyzes (only if there are consecutive stops yielding positive travel time savings after consolidation) and selects the combinations that give the best yields (travel time savings). The process is iterative in nature; a new route profile is created after every iteration which is analyzed in the next iteration. This maximizes the consolidation opportunities. The use of the combinatorial process can also be replaced by the use of a dynamic programming recursive approach in formulating the problem. Nonetheless, the execution effort undertaken by the combinatorial approach adopted here is quite reasonable given that the number of probable stops that can be consolidated is limited.

Researchers usually do sensitivity analysis by observing the first derivatives from a continuous approximation or study the finite differences in a discrete method. This study deals this process by a multi-level factorial experimental method by taking different response outputs of different hypothetical scenarios. Statistical methods were used to determine the important factors and their characteristics.

This study also pointed out the important determinants of the model by the experimental factorial design analysis. *Distance between stops* appeared to be the most important

factor. Chances of consolidation are higher in cases of closely spaced stops. These chances gradually decrease with the increase of stop spacing. Savings in the users travel and operating times are also more when stops are closely spaced.

The number of boarding and alighting passengers (*passengers' activity*) has important effect on consolidation and users' travel time savings. Chances of stop consolidation are higher when the level of *passengers' activity* is too low. A moderate level *passengers' activity* significantly decreases the chance of consolidation, while higher level of *passengers' activity* shows a tendency to increase this chance. The *passengers' activity* shows similar relationship with the *percentage of travel time savings*. The study recommends a comprehensive investigation on the effect of the *passengers' activity* on the *percentage of consolidated stops* and the *percentage of travel time savings*.

The factor *percentage of decreased passengers* proves to be important for stop consolidation and operating time savings. Although the passengers' loss decreases the revenue of the agency, the study found that it can increase the chance of consolidation and can actually improve the travel time.

The *maximum walkable distance* (or users' willingness to walk), which is an indicator of accessibility, shows significant effect on stop consolidation (see Section 5.3.3). The number of consolidated stops increases with the increase of the *maximum walkable distance*. Eventually, it increases the users travel time savings and decreases the trip times. Stop consolidation or savings in operating time do not depend much on the *frequency of service* or the *average cruising speed*. In a setting of high *frequency of service* and low *passengers' activity*, the *percentage of travel time savings* can increase.

6.2 Limitations of the Model

The model has certain limitations.

- The model does not account for the route path characteristics such as the number of intersections, and type of traffic control which may have some influence on the bus trip time. Since the model is developed to address all types of transit systems,

it uses the average link speed (average travel speed between two stops) to represent the route path characteristics.

- The model assumes that the schedule is uninterrupted. The schedule uncertainties are not modeled due to the complexity of the problem, and considered out of the scope of the work.
- The assumption of evenly distributed population throughout the route may be a bit unrealistic, though many researchers adopt this in their studies.
- Users are assumed to walk to and from the stop. In reality, people can use other modes as well.

6.3 Improvement of the Model and Future Study Opportunities

In this model, some inputs like door open/close time, boarding and alighting times per passenger are assumed. These values can be different depending on the type of transit vehicle, human characteristics or social influence, number of lift operation, etc. It is suggested to conduct surveys to accurately estimate these values.

This study investigated the relationship among the *distance between stops* (distance between analyzed stop and its subsequent stop) and the response variables. The effect of the distance between the analyzed stop and its preceding stop is not investigated. The effects of the combinations of these two distances and response variables can also be studied.

This model is based on maximizing users' benefit (travel time savings and accessibility) by stop consolidation. Although it is designed to retain the passengers, as it accounts users willingness to walk, few passengers might discontinue the service after the consolidation. The study shows that if the passenger loss is high, the chances of consolidation increase. Nonetheless, a high percentage of passenger loss is not desirable, as it can decrease the ridership and hence the revenue of the agency. Research can be done to investigate the tradeoff between travel time savings and loss of revenue due to loss of passengers.

There might be a relationship among the on-board passengers and the response variables (stop consolidation, travel time savings, operating time savings) which is not investigated in this study. The numbers of boarding and alighting passengers (separately) can have influence on the response variables. Consolidation of a stop can be affected by these attributes (boarding, alighting and on-board passengers) of the preceding and the consecutive stops. These issues can also be investigated.

As the model proved to be sensitive to the passengers' activity data, care should be taken to use this data. As the passengers' activity has hourly (peak, off-peak) and weekly (weekday, weekend) variations, the model outputs might be different for different passengers' activity data. A stop chosen for consolidation using one dataset might not be selected using another dataset. There are two alternative strategies to handle this issue: first, to use a single analysis with some average hourly passengers' activity, and second, to carry on multiple analyses with different hourly passengers' activity data. The second alternative needs further assessment to take consolidation decision. The model can also be improved to analyze multiple input datasets.

This model can also be improved to generate more outputs such as the change in walking distances, change in walking time, and change in in-vehicle time, etc. The value of the cost savings can also be included in the model. The modal splits to and from the stops may also be quite beneficial.

The research can be extended to develop a real time decision making system for stopping. By integrating real time information devices like AVL and smart phones, this system can inform the bus drivers ahead of time in which stoppage he have to stop or skip. This can also inform the passengers which nearby stop they have to go for boarding. This can save trip times and the transit operations will be better managed.

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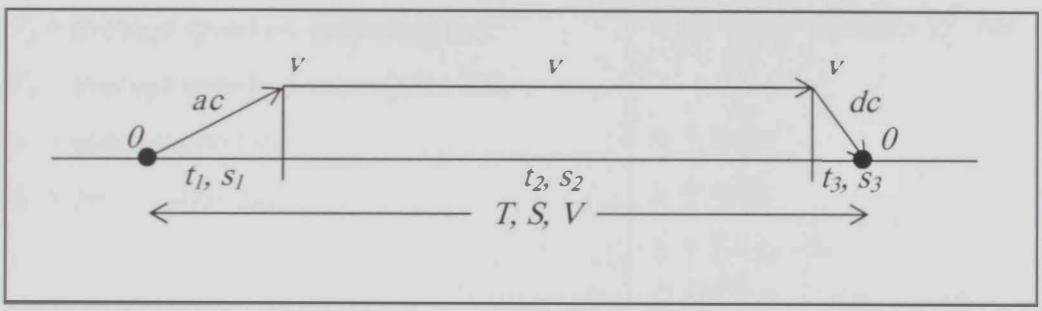
Annexure 1

CALCULATIONS

Calculations of Total Cruising Time and Average Link Speed

A transit vehicle starts from a stop with an acceleration of *ac*, to reach a velocity of *v* (average cruising speed), at time t_1 covering a distance of s_1. It continues its journey with the average velocity of *v* to cross a distance of s_2 (which takes a time interval of t_2) until it applies break to reach a stop. The decelerating rate is *dc*, and it takes an interval of t_3 to cross s_3 distance to stop. The entire journey takes *T* time interval (total cruising time) and it coveres a distance of *S* (distance between two stops).

Total cruising time (*T*) and the average speed on the link (*V*) can be calculated as follows:



The known values are:

v = average cruising speed on the link

S = link length

T = cruising time on the link

ac = acceleration rate

dc = deceleration rate

The values to be derieved are:

T = total cruising time on the link

V = average speed of the link

$t_1 = v/dc$

$t_3 = v/dc$

$s_1 = dc * t_1^2/2 = v^2/2dc$

$s_3 = dc * t_3^2/2 = v^2/2dc$

$s_2 = S - s_1 - s_3$

$= S - v^2/2ac - v^2/2dc$

$t_2 = s_2/v$

$= (S - v^2/2ac - v^2/2dc) / v$

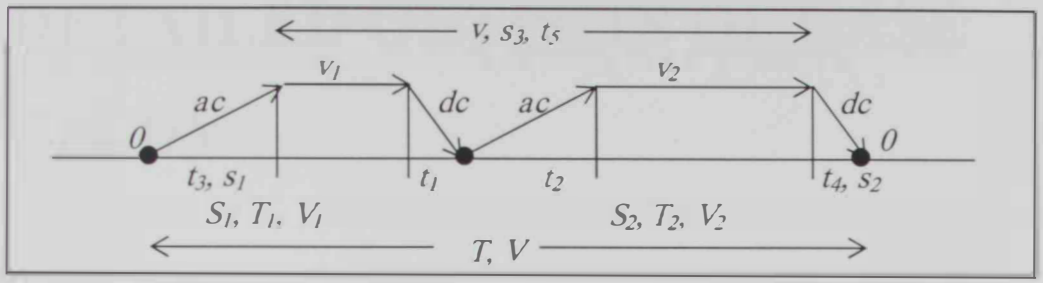
$= S/v - v/2ac - v/2dc$

$$\boldsymbol{T = v/ac + (s/v - v/2ac - v/2dc) + v/dc}$$

$$\boldsymbol{= v/2ac + v/2dc - s/v}$$

$$\boldsymbol{V = S/T}$$

Calculations of Cruising Time, Average Cruising Speed, and Average Link Speed After Consolidation



The known values are

v_1 = average cruising speed on preceding link

v_2 = average cruising speed on subsequent link

S_1 = distance from preceding stop

S_2 = distance to subsequent stop

T_1 = cruising time on preceding link

T_2 = cruising time on subsequent link

V_1 = average speed on preceding link

V_2 = average speed on subsequent link

ac = acceleration rate

dc = deceleration rate

Values to be derieved

T = cruising time after consolidation

v = average cruising speed after consolidation

V = average link speed after consolidation

$$T = T_1 + T_2 - t_1 - t_2$$

$$\boldsymbol{T = T_1 + T_2 - v_1/ac - v_2/dc}$$

$$\boldsymbol{V = T / (S_1 + S_2)}$$

$$s_1 = v_1^2/2ac$$

$$s_2 = v_2^2/2dc$$

$$s_3 = S_1 + S_2 - s_1 - s_2$$

$$= S_1 + S_2 - v_1^2/2ac - v_2^2/2dc$$

$$t_3 = v_1/ac$$

$$t_4 = v_2/dc$$

$$t_5 = T - t_3 - t_4$$

$$= (T_1 + T_2 - v_1/ac - v_2/dc) - v_1/ac - v_2/dc)$$

$$v = s_3/t_5$$

$$\boldsymbol{v = (S_1 + S_2 - v_1^2/2ac - v_2^2/2dc) / (T_1 + T_2 - v_1/2dc - v_2/2dc) - v_1/ac - v_2/dc)}$$

Annexure 2

DETAILED OUTPUTS OF CASE STUDY

A. Route 900, Hili Park to Bawadi Mall

B. Route 900, Bawadi Mall to Hili Park

C. Route 930, Al Fo'a Mall to Al Bateen

D. Route 930, Al Bateen to Al Fo'a Mall

Primary Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	885	0	0	0	0	0	38	1									
2	0	885	673	0	0	0	0	38	38	2									
3	0	673	547	0	0	0	0	38	41	3									
4	0	547	917	0	0	0	0	41	45	4									
5	0	917	612	0	0	1	1	45	40	5									
6	0	612	1157	0	0	1	2	40	42	6									
7	0	1157	610	0	0	4	6	42	44	7									
8	0	610	1069	0	0	0	6	44	39	8									
9	0	1069	1220	0	0	2	8	39	36	9									
10	0	1220	398	0	0	2	10	36	44	10									
11	0	398	560	0	0	1	11	44	45	11									
12	0	560	455	0	0	1	12	45	39	12									
13	0	455	647	0	0	1	13	39	37	13									
14	0	647	964	0	0	0	13	37	35	14									
15	0	964	565	0	0	0	13	35	38	15									
16	1	565	964	0	0	0	13	38	42	16									
17	1	964	678	0	0	0	13	42	10	17									
18	1	678	341	0	0	0	13	10	11	18									
19	0	341	402	0	3	0	13	11	20	19									
20	1	402	229	3	1	2	12	20	11	20									
21	0	229	296	1	2	1	12	11	16	21									
22	0	296	599	2	0	0	10	16	15	22									
23	0	599	459	0	0	0	10	15	20	23									
24	1	459	359	0	3	0	10	20	16	24									
25	0	359	161	3	3	14	21	16	18	25									
26	0	161	584	3	0	0	18	18	15	26									
27	1	584	579	0	0	9	27	15	14	27									
28	0	579	301	0	0	1	28	14	19	28									
29	0	301	1432	0	0	0	28	19	31	29									
30	0	1432	476	0	0	0	28	31	29	30									
31	0	476	1004	0	0	3	31	29	42	31									
32	0	1004	917	0	0	12	43	42	43	32									
33	0	917	1716	0	1	0	43	43	35	33									

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1716	995	1	7	0	42	35	44	34									
35	0	995	204	7	0	0	35	44	44	35									
36	0	204	497	0	0	0	35	44	41	36									
37	0	497	763	0	0	0	35	41	36	37									
38	0	763	557	0	16	0	35	36	26	38									
39	0	557	314	16	1	0	19	26	30	39									
40	0	314	410	1	2	1	19	30	26	40									
41	0	410	401	2	9	0	17	26	21	41									
42	0	401	581	9	0	0	8	21	29	42									
43	0	581	641	0	0	0	8	29	28	43									
44	0	641	1189	0	8	0	8	28	40	44									
45	0	1189	367	8	0	0	0	40	28	45									
46	1	367	0	0	0	0	0	28	0	46									

Iteration 1: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	885	0	0	0	0	0	38	1					0.00	0.00	97.04	0.00	9.12
2	0	885	673	0	0	0	0	38	38	2	0.00	0.00	0.00	0.00	0.00	97.04	76.95	9.12	8.75
3	0	673	547	0	0	0	0	38	41	3	0.00	0.00	0.00	0.00	0.00	76.95	62.27	8.75	8.78
4	0	547	917	0	0	0	0	41	45	4	0.00	0.00	0.00	0.00	0.00	62.27	88.99	8.78	10.31
5	0	917	612	0	0	1	1	45	40	5	0.37	0.63	0.00	0.00	0.00	88.99	68.97	10.31	8.87
6	0	612	1157	0	0	1	2	40	42	6	0.63	0.37	0.00	0.00	0.00	68.97	113.75	8.87	10.17
7	0	1157	610	0	0	4	6	42	44	7	1.28	2.72	0.00	0.00	0.00	113.75	65.19	10.17	9.36
8	0	610	1069	0	0	0	6	44	39	8	0.00	0.00	0.00	0.00	0.00	65.19	112.22	9.36	9.53
9	0	1069	1220	0	0	2	8	39	36	9	1.01	0.99	0.00	0.00	0.00	112.22	134.50	9.53	9.07
10	0	1220	398	0	0	2	10	36	44	10	0.45	1.55	0.00	0.00	0.00	134.50	47.84	9.07	8.32
11	0	398	560	0	0	1	11	44	45	11	0.55	0.45	0.00	0.00	3.19	47.84	60.43	8.32	9.27
12	0	560	455	0	0	1	12	45	39	12	0.42	0.58	0.00	0.00	3.15	60.43	55.54	9.27	8.19
13	0	455	647	0	0	1	13	39	37	13	0.55	0.45	0.00	0.00	2.99	55.54	75.80	8.19	8.54
14	0	647	964	0	0	0	13	37	35	14	0.00	0.00	0.00	0.00	0.00	75.80	111.31	8.54	8.66
15	0	964	565	0	0	0	13	35	38	15	0.00	0.00	0.00	0.00	0.00	111.31	66.72	8.66	8.47
16	1	565	964	0	0	0	13	38	42	16	0.00	0.00	0.00	0.00	0.00	66.72	97.21	8.47	9.92
17	1	964	678	0	0	0	13	42	10	17	0.00	0.00	0.00	0.00	0.00	97.21	247.55	9.92	2.74
18	1	678	341	0	0	0	13	10	11	18	0.00	0.00	0.00	0.00	0.00	247.55	115.42	2.74	2.95
19	0	341	402	0	3	0	13	11	20	19	0.00	0.00	0.00	0.00	3.82	115.42	79.30	2.95	5.07
20	1	402	229	3	1	2	12	20	11	20	0.63	1.37	1.25	1.75	0.00	79.30	78.76	5.07	2.91
21	0	229	296	1	2	1	12	11	16	21	0.47	0.53	0.66	0.34	0.15	78.76	72.16	2.91	4.10
22	0	296	599	2	0	0	10	16	15	22	0.00	0.00	1.45	0.55	-1.65	72.16	148.97	4.10	4.02
23	0	599	459	0	0	0	10	15	20	23	0.00	0.00	0.00	0.00	3.03	148.97	89.56	4.02	5.12
24	1	459	359	0	3	0	10	20	16	24	0.00	0.00	0.00	0.00	0.00	89.56	86.33	5.12	4.16
25	0	359	161	3	3	14	21	16	18	25	3.57	10.43	1.11	1.89	-16.62	86.33	38.45	4.16	4.19
26	0	161	584	3	0	0	18	18	15	26	0.00	0.00	2.48	0.52	0.77	38.45	145.37	4.19	4.02
27	1	584	579	0	0	9	27	15	14	27	3.86	5.14	0.00	0.00	0.00	145.37	153.75	4.02	3.77
28	0	579	301	0	0	1	28	14	19	28	0.28	0.72	0.00	0.00	5.61	153.75	63.63	3.77	4.73
29	0	301	1432	0	0	0	28	19	31	29	0.00	0.00	0.00	0.00	0.00	63.63	177.06	4.73	8.09
30	0	1432	476	0	0	0	28	31	29	30	0.00	0.00	0.00	0.00	0.00	177.06	69.16	8.09	6.88
31	0	476	1004	0	0	3	31	29	42	31	1.93	1.07	0.00	0.00	2.64	69.16	100.64	6.88	9.98
32	0	1004	917	0	0	12	43	42	43	32	5.40	6.60	0.00	0.00	0.00	100.64	91.70	9.98	10.00
33	0	917	1716	0	1	0	43	43	35	33	0.00	0.00	0.00	0.00	0.00	91.70	188.66	10.00	9.10

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1716	995	1	7	0	42	35	44	34	0.00	0.00	0.40	0.60	0.00	188.66	96.69	9.10	10.29
35	0	995	204	7	0	0	35	44	44	35	0.00	0.00	1.30	5.70	5.01	96.69	31.97	10.29	6.38
36	0	204	497	0	0	0	35	44	41	36	0.00	0.00	0.00	0.00	19.77	31.97	57.88	6.38	8.59
37	0	497	763	0	0	0	35	41	36	37	0.00	0.00	0.00	0.00	17.91	57.88	88.80	8.59	8.59
38	0	763	557	0	16	0	35	36	26	38	0.00	0.00	0.00	0.00	14.26	88.80	86.15	8.59	6.47
39	0	557	314	16	1	0	19	26	30	39	0.00	0.00	6.42	9.58	-30.25	86.15	48.10	6.47	6.53
40	0	314	410	1	2	1	19	30	26	40	0.52	0.48	0.61	0.39	3.00	48.10	65.80	6.53	6.23
41	0	410	401	2	9	0	17	26	21	41	0.00	0.00	1.08	0.92	0.85	65.80	76.03	6.23	5.27
42	0	401	581	9	0	0	8	21	29	42	0.00	0.00	5.77	3.23	-19.31	76.03	82.19	5.27	7.07
43	0	581	641	0	0	0	8	29	28	43	0.00	0.00	0.00	0.00	3.28	82.19	92.14	7.07	6.96
44	0	641	1189	0	8	0	8	28	40	44	0.00	0.00	0.00	0.00	0.00	92.14	120.90	6.96	9.83
45	0	1189	367	8	0	0	0	40	28	45	0.00	0.00	2.05	5.95	0.00	120.90	56.91	9.83	6.45
46	1	367	0	0	0	0	0	28	0	46					0.00	56.91	0.00	6.45	0.00

Iteration 1: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	885	0	0	0	0	0	38	1					0.00	0.00	97.04	0.00	9.12
2	0	885	673	0	0	0	0	38	38	2	0.00	0.00	0.00	0.00	0.00	97.04	76.95	9.12	8.75
3	0	673	547	0	0	0	0	38	41	3	0.00	0.00	0.00	0.00	0.00	76.95	62.27	8.75	8.78
4	0	547	917	0	0	0	0	41	45	4	0.00	0.00	0.00	0.00	0.00	62.27	88.99	8.78	10.31
5	0	917	612	0	0	1	1	45	40	5	0.37	0.63	0.00	0.00	0.00	88.99	68.97	10.31	8.87
6	0	612	1157	0	0	1	2	40	42	6	0.63	0.37	0.00	0.00	0.00	68.97	113.75	8.87	10.17
7	0	1157	610	0	0	4	6	42	44	7	1.28	2.72	0.00	0.00	0.00	113.75	65.19	10.17	9.36
8	0	610	1069	0	0	0	6	44	39	8	0.00	0.00	0.00	0.00	0.00	65.19	112.22	9.36	9.53
9	0	1069	1220	0	0	2	8	39	36	9	1.01	0.99	0.00	0.00	0.00	112.22	134.50	9.53	9.07
10	0	1220	958	0	0	2.552	10	36	44.672	10	0.45	1.55	0.00	0.00	0.00	134.50	92.71	9.07	10.33
Consolidated	0	398	560	0	0	1	11	44	45	11	0.55	0.45	0.00	0.00	3.19	47.84	60.43	8.32	9.27
12	0	958	1102	0	0	2.002	12	44.672	37.681	12	0.42	0.58	0.00	0.00	3.15	92.71	118.35	10.33	9.31
Consolidated	0	455	647	0	0	1	13	39	37	13	0.55	0.45	0.00	0.00	2.99	55.54	75.80	8.19	8.54
14	0	1102	964	0	0	0.446	13	37.681	35	14	0.00	0.00	0.00	0.00	0.00	118.35	111.31	9.31	8.66
15	0	964	565	0	0	0	13	35	38	15	0.00	0.00	0.00	0.00	0.00	111.31	66.72	8.66	8.47
16	1	565	964	0	0	0	13	38	42	16	0.00	0.00	0.00	0.00	0.00	66.72	97.21	8.47	9.92
17	1	964	678	0	0	0	13	42	10	17	0.00	0.00	0.00	0.00	0.00	97.21	247.55	9.92	2.74
18	1	678	743	0	0	0	13	10	14.558	18	0.00	0.00	0.00	0.00	0.00	247.55	188.40	2.74	3.94
Consolidated	0	341	402	0	3	0	13	11	20	19	0.00	0.00	0.00	0.00	3.82	115.42	79.30	2.95	5.07
20	1	743	525	3.656	1	2.467	12	14.558	13.384	20	0.63	1.37	1.25	1.75	0.00	188.40	145.71	3.94	3.60
Consolidated	0	229	296	1	2	1	12	11	16	21	0.47	0.53	0.66	0.34	0.15	78.76	72.16	2.91	4.10
22	0	525	1058	2.344	0	0.532	10	13.384	16.839	22	0.00	0.00	1.45	0.55	-1.65	145.71	231.94	3.60	4.56
Consolidated	0	599	459	0	0	0	10	15	20	23	0.00	0.00	0.00	0.00	3.03	148.97	89.56	4.02	5.12
24	1	1058	359	0	3	0	10	16.839	16	24	0.00	0.00	0.00	0.00	0.00	231.94	86.33	4.56	4.16
25	0	359	745	5.477	3	14	21	16	15.491	25	3.57	10.43	1.11	1.89	-16.62	86.33	178.40	4.16	4.18
Consolidated	0	161	584	3	0	0	18	18	15	26	0.00	0.00	2.48	0.52	0.77	38.45	145.37	4.19	4.02
27	1	745	880	0.523	0	9.279	27	15.491	15.388	27	3.86	5.14	0.00	0.00	0.00	178.40	211.13	4.18	4.17
Consolidated	0	579	301	0	0	1	28	14	19	28	0.28	0.72	0.00	0.00	5.61	153.75	63.63	3.77	4.73
29	0	880	1432	0	0	0.721	28	15.388	31	29	0.00	0.00	0.00	0.00	0.00	211.13	177.06	4.17	8.09
30	0	1432	1480	0	0	1.926	28	31	37.055	30	0.00	0.00	0.00	0.00	0.00	177.06	156.12	8.09	9.48
Consolidated	0	476	1004	0	0	3	31	29	42	31	1.93	1.07	0.00	0.00	2.64	69.16	100.64	6.88	9.98
32	0	1480	917	0	0	13.074	43	37.055	43	32	5.40	6.60	0.00	0.00	0.00	156.12	91.70	9.48	10.00
33	0	917	1716	0	1	0	43	43	35	33	0.00	0.00	0.00	0.00	0.00	91.70	188.66	10.00	9.10

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1716	995	1	7	0	42	35	44	34	0.00	0.00	0.40	0.60	0.00	188.66	96.69	9.10	10.29
35	0	995	701	7	0	0	35	44	41.296	35	0.00	0.00	1.30	5.70	5.01	96.69	75.40	10.29	9.30
Consolidated	0	204	497	0	0	0	35	44	41	36	0.00	0.00	0.00	0.00	19.77	31.97	57.88	6.38	8.59
37	0	701	1320	0	0	0	35	41.296	30.682	37	0.00	0.00	0.00	0.00	17.91	75.40	165.23	9.30	7.99
Consolidated	0	763	557	0	16	0	35	36	26	38	0.00	0.00	0.00	0.00	14.26	88.80	86.15	8.59	6.47
39	0	1320	724	16.608	1	0.524	19	30.682	27.392	39	0.00	0.00	6.42	9.58	-30.25	165.23	104.59	7.99	6.92
Consolidated	0	314	410	1	2	1	19	30	26	40	0.52	0.48	0.61	0.39	3.00	48.10	65.80	6.53	6.23
41	0	724	401	2.392	9	0.476	17	27.392	21	41	0.00	0.00	1.08	0.92	0.85	104.59	76.03	6.92	5.27
42	0	401	1222	9	0	0	8	21	28.443	42	0.00	0.00	5.77	3.23	-19.31	76.03	164.54	5.27	7.43
Consolidated	0	581	641	0	0	0	8	29	28	43	0.00	0.00	0.00	0.00	3.28	82.19	92.14	7.07	6.96
44	0	1222	1189	0	8	0	8	28.443	40	44	0.00	0.00	0.00	0.00	0.00	164.54	120.90	7.43	9.83
45	0	1189	367	8	0	0	0	40	28	45	0.00	0.00	2.05	5.95	0.00	120.90	56.91	9.83	6.45
46	1	367	0	0	0	0	0	28	0	46					0.00	56.91	0.00	6.45	0.00

Final Update in Iteration 1 or Primary Data Table for Iteration 2

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	885	0	0	0	0	0	38	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0	885	673	0	0	0	0	38	38	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	673	547	0	0	0	0	38	41	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	547	917	0	0	0	0	41	45	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	917	612	0	0	1	1	45	40	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	612	1157	0	0	1	2	40	42	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	1157	610	0	0	4	6	42	44	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0	610	1069	0	0	0	6	44	39	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0	1069	1220	0	0	2	8	39	36	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	1220	958	0	0	3	11	36	45	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	958	1102	0	0	2	13	45	38	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	1102	964	0	0	0	13	38	35	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0	964	565	0	0	0	13	35	38	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1	565	964	0	0	0	13	38	42	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1	964	678	0	0	0	13	42	10	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1	678	743	0	4	0	13	10	15	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1	743	525	4	2	2	11	15	13	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0	525	1058	2	0	1	10	13	17	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1	1058	359	0	5	0	10	17	16	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0	359	745	5	1	14	19	16	15	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	1	745	880	1	0	9	27	15	15	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0	880	1432	0	0	1	28	15	31	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0	1432	1480	0	0	2	30	31	37	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0	1480	917	0	0	13	43	37	43	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0	917	1716	0	1	0	43	43	35	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0	1716	995	1	7	0	42	35	44	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0	995	701	7	0	0	35	44	41	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0	701	1320	0	17	0	35	41	31	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0	1320	724	17	2	1	19	31	27	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0	724	401	2	9	0	17	27	21	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0	401	1222	9	0	0	8	21	28	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0	1222	1189	0	8	0	8	28	40	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0	1189	367	8	0	0	0	40	28	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	1	367	0	0	0	0	0	28	0	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 2: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	885	0	0	0	0	0	38	1	0.00	0.00	0.00	0.00	0.00	0.00	97.04	0.00	9.12
2	0	885	673	0	0	0	0	38	38	2	0.00	0.00	0.00	0.00	0.00	97.04	76.95	9.12	8.75
3	0	673	547	0	0	0	0	38	41	3	0.00	0.00	0.00	0.00	0.00	76.95	62.27	8.75	8.78
4	0	547	917	0	0	0	0	41	45	4	0.00	0.00	0.00	0.00	0.00	62.27	88.99	8.78	10.31
5	0	917	612	0	0	1	1	45	40	5	0.37	0.63	0.00	0.00	0.00	88.99	68.97	10.31	8.87
6	0	612	1157	0	0	1	2	40	42	6	0.63	0.37	0.00	0.00	0.00	68.97	113.75	8.87	10.17
7	0	1157	610	0	0	4	6	42	44	7	1.28	2.72	0.00	0.00	0.00	113.75	65.19	10.17	9.36
8	0	610	1069	0	0	0	6	44	39	8	0.00	0.00	0.00	0.00	0.00	65.19	112.22	9.36	9.53
9	0	1069	1220	0	0	2	8	39	36	9	1.01	0.99	0.00	0.00	0.00	112.22	134.50	9.53	9.07
10	0	1220	958	0	0	3	11	36	45	10	1.23	1.77	0.00	0.00	0.00	134.50	92.27	9.07	10.38
12	0	958	1102	0	0	2	13	45	38	11	1.02	0.98	0.00	0.00	0.00	92.27	117.59	10.38	9.37
14	0	1102	964	0	0	0	13	38	35	12	0.00	0.00	0.00	0.00	0.00	117.59	111.31	9.37	8.66
15	0	964	565	0	0	0	13	35	38	13	0.00	0.00	0.00	0.00	0.00	111.31	66.72	8.66	8.47
16	1	565	964	0	0	0	13	38	42	14	0.00	0.00	0.00	0.00	0.00	66.72	97.21	8.47	9.92
17	1	964	678	0	0	0	13	42	10	15	0.00	0.00	0.00	0.00	0.00	97.21	247.55	9.92	2.74
18	1	678	743	0	4	0	13	10	15	16	0.00	0.00	0.00	0.00	0.00	247.55	183.53	2.74	4.05
20	1	743	525	4	2	2	11	15	13	17	0.70	1.30	1.93	2.07	0.00	183.53	149.90	4.05	3.50
22	0	525	1058	2	0	1	10	13	17	18	0.59	0.41	1.47	0.53	0.00	149.90	229.95	3.50	4.60
24	1	1058	359	0	5	0	10	17	16	19	0.00	0.00	0.00	0.00	0.00	229.95	86.33	4.60	4.16
25	0	359	745	5	1	14	19	16	15	20	8.59	5.41	3.65	1.35	-50.60	86.33	184.01	4.16	4.05
27	1	745	880	1	0	9	27	15	15	21	4.25	4.75	0.61	0.39	0.00	184.01	216.41	4.05	4.07
29	0	880	1432	0	0	1	28	15	31	22	0.55	0.45	0.00	0.00	0.00	216.41	177.06	4.07	8.09
30	0	1432	1480	0	0	2	30	31	37	23	0.95	1.05	0.00	0.00	0.00	177.06	156.85	8.09	9.44
32	0	1480	917	0	0	13	43	37	43	24	4.62	8.38	0.00	0.00	0.00	156.85	91.70	9.44	10.00
33	0	917	1716	0	1	0	43	43	35	25	0.00	0.00	0.00	0.00	0.00	91.70	188.66	10.00	9.10
34	0	1716	995	1	7	0	42	35	44	26	0.00	0.00	0.40	0.60	0.00	188.66	96.69	9.10	10.29
35	0	995	701	7	0	0	35	44	41	27	0.00	0.00	3.08	3.92	0.00	96.69	75.79	10.29	9.25
37	0	701	1320	0	17	0	35	41	31	28	0.00	0.00	0.00	0.00	0.00	75.79	164.05	9.25	8.05
39	0	1320	724	17	2	1	19	31	27	29	0.32	0.68	6.57	10.43	0.00	164.05	105.91	8.05	6.84
41	0	724	401	2	9	0	17	27	21	30	0.00	0.00	0.79	1.21	-0.74	105.91	76.03	6.84	5.27
42	0	401	1222	9	0	0	8	21	28	31	0.00	0.00	7.11	1.89	0.00	76.03	166.84	5.27	7.32
44	0	1222	1189	0	8	0	8	28	40	32	0.00	0.00	0.00	0.00	0.00	166.84	120.90	7.32	9.83
45	0	1189	367	8	0	0	0	40	28	33	0.00	0.00	2.05	5.95	0.00	120.90	56.91	9.83	6.45
46	1	367	0	0	0	0	0	28	0	34	0.00	0.00	0.00	0.00	0.00	56.91	0.00	6.45	0.00

Primary Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	296	0	0	0	0	0	21	1									
2	0	296	1065	0	0	0	0	21	29	2									
3	0	1065	608	0	0	0	0	29	22	3									
4	0	608	373	0	0	0	0	22	20	4									
5	0	373	196	0	1	2	2	20	21	5									
6	0	196	233	1	0	0	1	21	29	6									
7	0	233	523	0	0	2	3	29	25	7									
8	0	523	515	0	0	0	3	25	24	8									
9	0	515	707	0	1	0	3	24	27	9									
10	0	707	682	1	0	5	7	27	39	10									
11	0	682	507	0	0	2	9	39	44	11									
12	0	507	1223	0	0	11	20	44	40	12									
13	0	1223	2540	0	0	1	21	40	39	13									
14	0	2540	711	0	0	4	25	39	35	14									
15	0	711	861	0	0	3	28	35	38	15									
16	0	861	805	0	0	2	30	38	42	16									
17	0	805	468	0	0	1	31	42	35	17									
18	0	468	428	0	0	4	35	35	15	18									
19	0	428	589	0	0	0	35	15	14	19									
20	1	589	570	0	0	0	35	14	17	20									
21	0	570	185	0	0	1	36	17	17	21									
22	0	185	270	0	0	2	38	17	20	22									
23	0	270	166	0	0	0	38	20	13	23									
24	1	166	391	0	0	0	38	13	12	24									
25	0	391	917	0	0	2	40	12	19	25									
26	0	917	198	0	0	0	40	19	15	26									
27	1	198	359	0	3	0	40	15	19	27									
28	0	359	435	3	2	0	37	19	18	28									
29	0	435	604	2	2	0	35	18	34	29									
30	1	604	267	2	0	0	33	34	35	30									
31	0	267	772	0	9	0	33	35	28	31									
32	0	772	597	9	2	5	29	28	32	32									
33	0	597	288	2	1	2	29	32	32	33									

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	288	620	1	1	3	31	32	30	34									
35	0	620	673	1	1	0	30	30	44	35									
36	0	673	375	1	2	0	29	44	37	36									
37	0	375	602	2	4	0	27	37	40	37									
38	0	602	360	4	5	0	23	40	41	38									
39	0	360	343	5	2	0	18	41	39	39									
40	0	343	866	2	1	0	16	39	39	40									
41	0	866	853	1	1	0	15	39	40	41									
42	0	853	332	1	1	0	14	40	37	42									
43	0	332	608	1	2	0	13	37	43	43									
44	0	608	795	2	1	0	11	43	38	44									
45	0	795	398	1	3	0	10	38	40	45									
46	0	398	562	3	0	0	7	40	44	46									
47	0	562	731	0	2	0	7	44	41	47									
48	0	731	349	2	1	0	5	41	39	48									
49	0	349	518	1	0	0	4	39	39	49									
50	0	518	576	0	0	0	4	39	39	50									
51	0	576	924	0	4	0	4	39	38	51									
52	1	924	0	4	0	0	0	38	0	52									

Iteration 1: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	296	0	0	0	0	0	21	1					0.00	0.00	58.03	0.00	5.10
2	0	296	1065	0	0	0	0	21	29	2	0.00	0.00	0.00	0.00	0.00	58.03	142.28	5.10	7.49
3	0	1065	608	0	0	0	0	29	22	3	0.00	0.00	0.00	0.00	0.00	142.28	107.13	7.49	5.68
4	0	608	373	0	0	0	0	22	20	4	0.00	0.00	0.00	0.00	0.00	107.13	74.08	5.68	5.03
5	0	373	196	0	1	2	2	20	21	5	0.59	1.41	0.00	0.00	-2.71	74.08	40.89	5.03	4.79
6	0	196	233	1	0	0	1	21	29	6	0.00	0.00	0.60	0.40	-0.73	40.89	38.99	4.79	5.98
7	0	233	523	0	0	2	3	29	25	7	1.30	0.70	0.00	0.00	-3.53	38.99	83.99	5.98	6.23
8	0	523	515	0	0	0	3	25	24	8	0.00	0.00	0.00	0.00	1.09	83.99	85.58	6.23	6.02
9	0	515	707	0	1	0	3	24	27	9	0.00	0.00	0.00	0.00	1.17	85.58	103.64	6.02	6.82
10	0	707	682	1	0	5	7	27	39	10	2.25	2.75	0.53	0.47	-24.19	103.64	76.50	6.82	8.92
11	0	682	507	0	0	2	9	39	44	11	0.79	1.21	0.00	0.00	-2.74	76.50	56.76	8.92	8.93
12	0	507	1223	0	0	11	20	44	40	12	7.49	3.51	0.00	0.00	0.00	56.76	123.96	8.93	9.87
13	0	1223	2540	0	0	1	21	40	39	13	0.65	0.35	0.00	0.00	0.00	123.96	248.00	9.87	10.24
14	0	2540	711	0	0	4	25	39	35	14	0.80	3.20	0.00	0.00	0.00	248.00	85.28	10.24	8.34
15	0	711	861	0	0	3	28	35	38	15	1.54	1.46	0.00	0.00	0.00	85.28	94.76	8.34	9.09
16	0	861	805	0	0	2	30	38	42	16	0.91	1.09	0.00	0.00	0.00	94.76	83.58	9.09	9.63
17	0	805	468	0	0	1	31	42	35	17	0.34	0.66	0.00	0.00	11.82	83.58	60.29	9.63	7.76
18	0	468	428	0	0	4	35	35	15	18	1.77	2.23	0.00	0.00	0.89	60.29	107.93	7.76	3.97
19	0	428	589	0	0	0	35	15	14	19	0.00	0.00	0.00	0.00	8.67	107.93	156.32	3.97	3.77
20	1	589	570	0	0	0	35	14	17	20	0.00	0.00	0.00	0.00	0.00	156.32	126.61	3.77	4.50
21	0	570	185	0	0	1	36	17	17	21	0.20	0.80	0.00	0.00	8.38	126.61	45.08	4.50	4.10
22	0	185	270	0	0	2	38	17	20	22	1.05	0.95	0.00	0.00	8.42	45.08	55.54	4.10	4.86
23	0	270	166	0	0	0	38	20	13	23	0.00	0.00	0.00	0.00	9.50	55.54	50.48	4.86	3.29
24	1	166	391	0	0	0	38	13	12	24	0.00	0.00	0.00	0.00	0.00	50.48	121.47	3.29	3.22
25	0	391	917	0	0	2	40	12	19	25	1.25	0.75	0.00	0.00	3.37	121.47	180.34	3.22	5.08
26	0	917	198	0	0	0	40	19	15	26	0.00	0.00	0.00	0.00	10.65	180.34	52.73	5.08	3.76
27	1	198	359	0	3	0	40	15	19	27	0.00	0.00	0.00	0.00	0.00	52.73	74.62	3.76	4.81
28	0	359	435	3	2	0	37	19	18	28	0.00	0.00	1.81	1.19	4.19	74.62	93.25	4.81	4.66
29	0	435	604	2	2	0	35	18	34	29	0.00	0.00	1.28	0.72	10.43	93.25	75.76	4.66	7.97
30	1	604	267	2	0	0	33	34	35	30	0.00	0.00	0.67	1.33	0.00	75.76	39.62	7.97	6.74
31	0	267	772	0	9	0	33	35	28	31	0.00	0.00	0.00	0.00	13.98	39.62	108.98	6.74	7.08
32	0	772	597	9	2	5	29	28	32	32	1.99	3.01	4.28	4.72	-44.14	108.98	78.27	7.08	7.63
33	0	597	288	2	1	2	29	32	32	33	0.59	1.41	0.72	1.28	3.21	78.27	43.51	7.63	6.62

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	288	620	1	1	3	31	32	30	34	1.94	1.06	0.72	0.28	2.81	43.51	84.82	6.62	7.31
35	0	620	673	1	1	0	30	30	44	35	0.00	0.00	0.56	0.44	13.19	84.82	70.34	7.31	9.57
36	0	673	375	1	2	0	29	44	37	36	0.00	0.00	0.38	0.62	12.30	70.34	49.33	9.57	7.60
37	0	375	602	2	4	0	27	37	40	37	0.00	0.00	1.30	0.70	9.36	49.33	68.07	7.60	8.84
38	0	602	360	4	5	0	23	40	41	38	0.00	0.00	1.62	2.38	1.76	68.07	45.85	8.84	7.85
39	0	360	343	5	2	0	18	41	39	39	0.00	0.00	2.62	2.38	-0.70	45.85	45.20	7.85	7.59
40	0	343	866	2	1	0	16	39	39	40	0.00	0.00	1.49	0.51	3.14	45.20	93.48	7.59	9.26
41	0	866	853	1	1	0	15	39	40	41	0.00	0.00	0.53	0.47	0.00	93.48	90.66	9.26	9.41
42	0	853	332	1	1	0	14	40	37	42	0.00	0.00	0.30	0.70	4.24	90.66	45.15	9.41	7.35
43	0	332	608	1	2	0	13	37	43	43	0.00	0.00	0.68	0.32	5.00	45.15	65.83	7.35	9.24
44	0	608	795	2	1	0	11	43	38	44	0.00	0.00	1.19	0.81	-2.23	65.83	88.51	9.24	8.98
45	0	795	398	1	3	0	10	38	40	45	0.00	0.00	0.36	0.64	2.16	88.51	49.71	8.98	8.01
46	0	398	562	3	0	0	7	40	44	46	0.00	0.00	1.86	1.14	-3.88	49.71	61.26	8.01	9.17
47	0	562	731	0	2	0	7	44	41	47	0.00	0.00	0.00	0.00	3.95	61.26	78.42	9.17	9.32
48	0	731	349	2	1	0	5	41	39	48	0.00	0.00	0.70	1.30	-3.19	78.42	45.76	9.32	7.63
49	0	349	518	1	0	0	4	39	39	49	0.00	0.00	0.63	0.37	-0.24	45.76	61.36	7.63	8.44
50	0	518	576	0	0	0	4	39	39	50	0.00	0.00	0.00	0.00	2.14	61.36	66.71	8.44	8.63
51	0	576	924	0	4	0	4	39	38	51	0.00	0.00	0.00	0.00	2.10	66.71	100.73	8.63	9.17
52	1	924	0	4	0	0	0	38	0	52					0.00	100.73	0.00	9.17	0.00

Iteration 1: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	296	0	0	0	0	0	21	1					0.00	0.00	58.03	0.00	5.10
2	0	296	1065	0	0	0	0	21	29	2	0.00	0.00	0.00	0.00	0.00	58.03	142.28	5.10	7.49
3	0	1065	608	0	0	0	0	29	22	3	0.00	0.00	0.00	0.00	0.00	142.28	107.13	7.49	5.68
4	0	608	373	0	0	0	0	22	20	4	0.00	0.00	0.00	0.00	0.00	107.13	74.08	5.68	5.03
5	0	373	196	0	1	2	2	20	21	5	0.59	1.41	0.00	0.00	-2.71	74.08	40.89	5.03	4.79
6	0	196	233	1	0	0	1	21	29	6	0.00	0.00	0.60	0.40	-0.73	40.89	38.99	4.79	5.98
7	0	233	1038	0	0	2	3	29	24.475	7	1.30	0.70	0.00	0.00	-3.53	38.99	161.17	5.98	6.44
Consolidated	0	523	515	0	0	0	3	25	24	8	0.00	0.00	0.00	0.00	1.09	83.99	85.58	6.23	6.02
9	0	1038	707	0	1	0	3	24.475	27	9	0.00	0.00	0.00	0.00	1.17	161.17	103.64	6.44	6.82
10	0	707	682	1	0	5	7	27	39	10	2.25	2.75	0.53	0.47	-24.19	103.64	76.50	6.82	8.92
11	0	682	507	0	0	2	9	39	44	11	0.79	1.21	0.00	0.00	-2.74	76.50	56.76	8.92	8.93
12	0	507	1223	0	0	11	20	44	40	12	7.49	3.51	0.00	0.00	0.00	56.76	123.96	8.93	9.87
13	0	1223	2540	0	0	1	21	40	39	13	0.65	0.35	0.00	0.00	0.00	123.96	248.00	9.87	10.24
14	0	2540	711	0	0	4	25	39	35	14	0.80	3.20	0.00	0.00	0.00	248.00	85.28	10.24	8.34
15	0	711	861	0	0	3	28	35	38	15	1.54	1.46	0.00	0.00	0.00	85.28	94.76	8.34	9.09
16	0	861	1273	0	0	2.341	30	38	38.895	16	0.91	1.09	0.00	0.00	0.00	94.76	131.23	9.09	9.70
Consolidated	0	805	468	0	0	1	31	42	35	17	0.34	0.66	0.00	0.00	11.82	83.58	60.29	9.63	7.76
18	0	1273	1017	0	0	4.659	35	38.895	14.396	18	1.77	2.23	0.00	0.00	0.89	131.23	259.32	9.70	3.92
Consolidated	0	428	589	0	0	0	35	15	14	19	0.00	0.00	0.00	0.00	8.67	107.93	156.32	3.97	3.77
20	1	1017	755	0	0	0.202	35	14.396	17	20	0.00	0.00	0.00	0.00	0.00	259.32	165.79	3.92	4.55
Consolidated	0	570	185	0	0	1	36	17	17	21	0.20	0.80	0.00	0.00	8.38	126.61	45.08	4.50	4.10
22	0	755	436	0	0	2.798	38	17	16.420	22	1.05	0.95	0.00	0.00	8.42	165.79	101.03	4.55	4.32
Consolidated	0	270	166	0	0	0	38	20	13	23	0.00	0.00	0.00	0.00	9.50	55.54	50.48	4.86	3.29
24	1	436	391	0	0	0	38	16.420	12	24	0.00	0.00	0.00	0.00	0.00	101.03	121.47	4.32	3.22
25	0	391	1115	0	0	2	40	12	18.135	25	1.25	0.75	0.00	0.00	3.37	121.47	227.59	3.22	4.90
Consolidated	0	917	198	0	0	0	40	19	15	26	0.00	0.00	0.00	0.00	10.65	180.34	52.73	5.08	3.76
27	1	1115	359	0	3	0	40	18.135	19	27	0.00	0.00	0.00	0.00	0.00	227.59	74.62	4.90	4.81
28	0	359	1039	4.276	2	0	37	19	24.863	28	0.00	0.00	1.81	1.19	4.19	74.62	158.31	4.81	6.56
Consolidated	0	435	604	2	2	0	35	18	34	29	0.00	0.00	1.28	0.72	10.43	93.25	75.76	4.66	7.97
30	1	1039	1039	2.724	0	0	33	24.863	29.080	30	0.00	0.00	0.67	1.33	0.00	158.31	138.39	6.56	7.51
Consolidated	0	267	772	0	9	0	33	35	28	31	0.00	0.00	0.00	0.00	13.98	39.62	108.98	6.74	7.08
32	0	1039	885	9.716	2	5.588	29	29.079	32	32	1.99	3.01	4.28	4.72	-44.14	138.39	110.67	7.51	8.00
Consolidated	0	597	288	2	1	2	29	32	32	33	0.59	1.41	0.72	1.28	3.21	78.27	43.51	7.63	6.62

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	885	1293	2.842	1	4.411	31	32	36.166	34	1.94	1.06	0.72	0.28	2.81	110.67	140.85	8.00	9.18
Consolidated	0	620	673	1	1	0	30	30	44	35	0.00	0.00	0.56	0.44	13.19	84.82	70.34	7.31	9.57
36	0	1293	977	2.742	2	0	29	36.166	38.987	36	0.00	0.00	0.38	0.62	12.30	140.85	103.72	9.18	9.42
Consolidated	0	375	602	2	4	0	27	37	40	37	0.00	0.00	1.30	0.70	9.36	49.33	68.07	7.60	8.84
38	0	977	360	4.700	5	0	23	38.987	41	38	0.00	0.00	1.62	2.38	1.76	103.72	45.85	9.42	7.85
39	0	360	1209	6.490	2	0	18	41	39	39	0.00	0.00	2.62	2.38	-0.70	45.85	125.14	7.85	9.66
Consolidated	0	343	866	2	1	0	16	39	39	40	0.00	0.00	1.49	0.51	3.14	45.20	93.48	7.59	9.26
41	0	1209	853	1.510	1	0	15	39	40	41	0.00	0.00	0.53	0.47	0.00	125.14	90.66	9.66	9.41
42	0	853	940	1.681	1	0	14	40	41.111	42	0.00	0.00	0.30	0.70	4.24	90.66	96.47	9.41	9.74
Consolidated	0	332	608	1	2	0	13	37	43	43	0.00	0.00	0.68	0.32	5.00	45.15	65.83	7.35	9.24
44	0	940	1193	2.681	1	0	11	41.1106	38.676	44	0.00	0.00	1.19	0.81	-2.23	96.47	124.47	9.74	9.58
Consolidated	0	795	398	1	3	0	10	38	40	45	0.00	0.00	0.36	0.64	2.16	88.51	49.71	8.98	8.01
46	0	1193	1293	3.638	0	0	7	38.676	42.065	46	0.00	0.00	1.86	1.14	-3.88	124.47	125.24	9.58	10.32
Consolidated	0	562	731	0	2	0	7	44	41	47	0.00	0.00	0.00	0.00	3.95	61.26	78.42	9.17	9.32
48	0	1293	349	2	1	0	5	42.065	39	48	0.00	0.00	0.70	1.30	-3.19	125.24	45.76	10.32	7.63
49	0	349	1094	1	0	0	4	39	39	49	0.00	0.00	0.63	0.37	-0.24	45.76	114.53	7.63	9.55
Consolidated	0	518	576	0	0	0	4	39	39	50	0.00	0.00	0.00	0.00	2.14	61.36	66.71	8.44	8.63
51	0	1094	924	0	4	0	4	39	38	51	0.00	0.00	0.00	0.00	2.10	114.53	100.73	9.55	9.17
52	1	924	0	4	0	0	0	38	0	52					0.00	100.73	0.00	9.17	0.00

Final Update in Iteration 1 or Primary Data Table for iteration 2

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	296	0	0	0	0	0	21	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0	296	1065	0	0	0	0	21	29	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	1065	608	0	0	0	0	29	22	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	608	373	0	0	0	0	22	20	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	373	196	0	1	2	2	20	21	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	196	233	1	0	0	1	21	29	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	233	1038	0	0	2	3	29	24	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0	1038	707	0	1	0	3	24	27	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	707	682	1	0	5	7	27	39	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0	682	507	0	0	2	9	39	44	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	507	1223	0	0	11	20	44	40	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0	1223	2540	0	0	1	21	40	39	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	2540	711	0	0	4	25	39	35	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0	711	861	0	0	3	28	35	38	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0	861	1273	0	0	2	30	38	39	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0	1273	1017	0	0	5	35	39	14	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1	1017	755	0	0	0	35	14	17	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0	755	436	0	0	3	38	17	16	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1	436	391	0	0	0	38	16	12	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0	391	1115	0	0	2	40	12	18	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	1	1115	359	0	4	0	40	18	19	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0	359	1039	4	3	0	36	19	25	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1	1039	1039	3	10	0	33	25	29	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0	1039	885	10	3	6	29	29	32	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0	885	1293	3	3	4	30	32	36	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0	1293	977	3	5	0	27	36	39	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0	977	360	5	6	0	22	39	41	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0	360	1209	6	2	0	16	41	39	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0	1209	853	2	2	0	14	39	40	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0	853	940	2	3	0	12	40	41	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0	940	1193	3	4	0	9	41	39	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0	1193	1293	4	2	0	5	39	42	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0	1293	349	2	1	0	3	42	39	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
49	0	349	1094	1	0	0	2	39	39	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0	1094	924	0	4	0	2	39	38	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	1	924	0	2	0	0	0	38	0	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 2: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	296	0	0	0	0	0	21	1	0.00	0.00	0.00	0.00	0.00	0.00	58.03	0.00	5.10
2	0	296	1065	0	0	0	0	21	29	2	0.00	0.00	0.00	0.00	0.00	58.03	142.28	5.10	7.49
3	0	1065	608	0	0	0	0	29	22	3	0.00	0.00	0.00	0.00	0.00	142.28	107.13	7.49	5.68
4	0	608	373	0	0	0	0	22	20	4	0.00	0.00	0.00	0.00	0.00	107.13	74.08	5.68	5.03
5	0	373	196	0	1	2	2	20	21	5	0.59	1.41	0.00	0.00	-2.71	74.08	40.89	5.03	4.79
6	0	196	233	1	0	0	1	21	29	6	0.00	0.00	0.60	0.40	-0.73	40.89	38.99	4.79	5.98
7	0	233	1038	0	0	2	3	29	24	7	1.57	0.43	0.00	0.00	-4.38	38.99	164.03	5.98	6.33
9	0	1038	707	0	1	0	3	24	27	8	0.00	0.00	0.00	0.00	0.00	164.03	103.64	6.33	6.82
10	0	707	682	1	0	5	7	27	39	9	2.25	2.75	0.53	0.47	-24.19	103.64	76.50	6.82	8.92
11	0	682	507	0	0	2	9	39	44	10	0.79	1.21	0.00	0.00	-2.74	76.50	56.76	8.92	8.93
12	0	507	1223	0	0	11	20	44	40	11	7.49	3.51	0.00	0.00	0.00	56.76	123.96	8.93	9.87
13	0	1223	2540	0	0	1	21	40	39	12	0.65	0.35	0.00	0.00	0.00	123.96	248.00	9.87	10.24
14	0	2540	711	0	0	4	25	39	35	13	0.80	3.20	0.00	0.00	0.00	248.00	85.28	10.24	8.34
15	0	711	861	0	0	3	28	35	38	14	1.54	1.46	0.00	0.00	0.00	85.28	94.76	8.34	9.09
16	0	861	1273	0	0	2	30	38	39	15	1.13	0.87	0.00	0.00	0.00	94.76	131.05	9.09	9.71
18	0	1273	1017	0	0	5	35	39	14	16	2.08	2.92	0.00	0.00	0.00	131.05	266.38	9.71	3.82
20	1	1017	755	0	0	0	35	14	17	17	0.00	0.00	0.00	0.00	0.00	266.38	165.79	3.82	4.55
22	0	755	436	0	0	3	38	17	16	18	0.93	2.07	0.00	0.00	0.69	165.79	103.66	4.55	4.21
24	1	436	391	0	0	0	38	16	12	19	0.00	0.00	0.00	0.00	0.00	103.66	121.47	4.21	3.22
25	0	391	1115	0	0	2	40	12	18	20	1.34	0.66	0.00	0.00	0.00	121.47	229.25	3.22	4.86
27	1	1115	359	0	4	0	40	18	19	21	0.00	0.00	0.00	0.00	0.00	229.25	74.62	4.86	4.81
28	0	359	1039	4	3	0	36	19	25	22	0.00	0.00	3.14	0.86	2.26	74.62	158.30	4.81	6.56
30	1	1039	1039	3	10	0	33	25	29	23	0.00	0.00	1.63	1.37	0.00	158.30	139.05	6.56	7.47
32	0	1039	885	10	3	6	29	29	32	24	2.54	3.46	4.97	5.03	0.00	139.05	110.67	7.47	8.00
34	0	885	1293	3	3	4	30	32	36	25	2.24	1.76	1.88	1.12	0.00	110.67	141.80	8.00	9.12
36	0	1293	977	3	5	0	27	36	39	26	0.00	0.00	1.38	1.62	0.00	141.80	103.73	9.12	9.42
38	0	977	360	5	6	0	22	39	41	27	0.00	0.00	1.47	3.53	-4.28	103.73	45.85	9.42	7.85
39	0	360	1209	6	2	0	16	41	39	28	0.00	0.00	4.77	1.23	0.00	45.85	125.14	7.85	9.66
41	0	1209	853	2	2	0	14	39	40	29	0.00	0.00	0.88	1.12	0.00	125.14	90.66	9.66	9.41
42	0	853	940	2	3	0	12	40	41	30	0.00	0.00	1.11	0.89	0.00	90.66	96.77	9.41	9.71
44	0	940	1193	3	4	0	9	41	39	31	0.00	0.00	1.76	1.24	0.00	96.77	123.66	9.71	9.65
46	0	1193	1293	4	2	0	5	39	42	32	0.00	0.00	2.20	1.80	0.00	123.66	125.41	9.65	10.31
48	0	1293	349	2	1	0	3	42	39	33	0.00	0.00	0.46	1.54	0.00	125.41	45.76	10.31	7.63

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
49	0	349	1094	1	0	0	2	39	39	34	0.00	0.00	0.78	0.22	-1.82	45.76	114.53	7.63	9.55
51	0	1094	924	0	4	0	2	39	38	35	0.00	0.00	0.00	0.00	0.00	114.53	100.73	9.55	9.17
52	1	924	0	2	0	0	0	38	0	36	0.00	0.00	0.00	0.00	0.00	100.73	0.00	9.17	0.00

Primary Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	776	0	0	13	13	0	50	1									
2	0	776	467	0	0	1	14	50	42	2									
3	0	467	1069	0	0	1	15	42	48	3									
4	0	1069	1460	0	0	4	19	48	42	4									
5	0	1460	632	0	0	0	19	42	50	5									
6	0	632	1118	0	0	0	19	50	40	6									
7	0	1118	1711	0	0	2	21	40	36	7									
8	1	1711	1011	0	0	1	22	36	50	8									
9	0	1011	861	0	0	1	23	50	50	9									
10	0	861	729	0	0	0	23	50	40	10									
11	0	729	566	0	0	0	23	40	38	11									
12	0	566	623	0	0	1	24	38	41	12									
13	0	623	393	0	0	0	24	41	44	13									
14	0	393	909	0	0	3	27	44	45	14									
15	1	909	520	0	0	0	27	45	36	15									
16	0	520	613	0	0	1	28	36	37	16									
17	0	613	330	0	0	4	32	37	43	17									
18	0	330	465	0	0	2	34	43	39	18									
19	0	465	550	0	0	2	36	39	32	19									
20	0	550	636	0	0	1	37	32	27	20									
21	1	636	978	0	2	0	37	27	25	21									
22	1	978	563	2	0	0	35	25	30	22									
23	1	563	694	0	5	0	35	30	25	23									
24	0	694	391	5	0	2	32	25	20	24									
25	0	391	233	0	0	1	33	20	24	25									
26	1	233	298	0	3	4	37	24	19	26									
27	0	298	826	3	1	1	35	19	24	27									
28	0	826	481	1	30	0	34	24	15	28									
29	0	481	299	30	0	6	10	15	19	29									
30	1	299	187	0	0	3	13	19	13	30									
31	0	187	277	0	0	1	14	13	12	31									
32	0	277	212	0	0	0	14	12	14	32									
33	1	212	1598	0	1	1	15	14	44	33									

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1598	845	1	2	0	14	44	38	34									
35	0	845	502	2	1	0	12	38	37	35									
36	0	502	1157	1	0	0	11	37	38	36									
37	0	1157	827	0	0	0	11	38	45	37									
38	0	827	571	0	1	0	11	45	38	38									
39	1	571	1127	1	0	1	11	38	43	39									
40	0	1127	624	0	0	1	12	43	43	40									
41	0	624	407	0	0	0	12	43	35	41									
42	0	407	1036	0	0	0	12	35	42	42									
43	0	1036	760	0	1	0	12	42	39	43									
44	0	760	1225	1	0	0	11	39	39	44									
45	0	1225	628	0	1	0	11	39	40	45									
46	0	628	1495	1	2	0	10	40	36	46									
47	0	1495	501	2	1	0	8	36	42	47									
48	0	501	1128	1	2	0	7	42	45	48									
49	0	1128	632	2	0	0	5	45	43	49									
50	0	632	708	0	1	0	5	43	20	50									
51	1	708	420	1	1	0	4	20	25	51									
52	0	420	1247	1	0	0	3	25	19	52									
53	0	1247	542	0	0	0	3	19	40	53									
54	0	542	2221	0	0	1	4	40	38	54									
55	0	2221	764	0	2	0	4	38	43	55									
56	0	764	937	2	0	0	2	43	43	56									
57	0	937	398	0	0	0	2	43	39	57									
58	0	398	724	0	0	0	2	39	42	58									
59	0	724	1041	0	2	0	2	42	41	59									
60	1	1041	0	2	0	0	0	41	0	60									

Iteration 1: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	776	0	0	13	13	0	50	1					0.00	0.00	73.23	0.00	10.60
2	0	776	467	0	0	1	14	50	42	2	0.35	0.65	0.00	0.00	4.34	73.23	54.61	10.60	8.55
3	0	467	1069	0	0	1	15	42	48	3	0.67	0.33	0.00	0.00	0.00	54.61	96.84	8.55	11.04
4	0	1069	1460	0	0	4	19	48	42	4	2.21	1.79	0.00	0.00	0.00	96.84	139.73	11.04	10.45
5	0	1460	632	0	0	0	19	42	50	5	0.00	0.00	0.00	0.00	0.00	139.73	62.87	10.45	10.05
6	0	632	1118	0	0	0	19	50	40	6	0.00	0.00	0.00	0.00	0.00	62.87	114.51	10.05	9.76
7	0	1118	1711	0	0	2	21	40	36	7	1.15	0.85	0.00	0.00	0.00	114.51	183.60	9.76	9.32
8	1	1711	1011	0	0	1	22	36	50	8	0.34	0.66	0.00	0.00	0.00	183.60	90.15	9.32	11.21
9	0	1011	861	0	0	1	23	50	50	9	0.44	0.56	0.00	0.00	0.00	90.15	79.35	11.21	10.85
10	0	861	729	0	0	0	23	50	40	10	0.00	0.00	0.00	0.00	0.00	79.35	79.50	10.85	9.17
11	0	729	566	0	0	0	23	40	38	11	0.00	0.00	0.00	0.00	12.14	79.50	66.82	9.17	8.47
12	0	566	623	0	0	1	24	38	41	12	0.49	0.51	0.00	0.00	9.12	66.82	68.94	8.47	9.04
13	0	623	393	0	0	0	24	41	44	13	0.00	0.00	0.00	0.00	14.06	68.94	47.43	9.04	8.29
14	0	393	909	0	0	3	27	44	45	14	2.01	0.99	0.00	0.00	4.13	47.43	88.35	8.29	10.29
15	1	909	520	0	0	0	27	45	36	15	0.00	0.00	0.00	0.00	0.00	88.35	64.50	10.29	8.06
16	0	520	613	0	0	1	28	36	37	16	0.51	0.49	0.00	0.00	10.39	64.50	72.49	8.06	8.46
17	0	613	330	0	0	4	32	37	43	17	1.28	2.72	0.00	0.00	6.12	72.49	42.56	8.46	7.75
18	0	330	465	0	0	2	34	43	39	18	1.10	0.90	0.00	0.00	12.76	42.56	56.46	7.75	8.24
19	0	465	550	0	0	2	36	39	32	19	1.02	0.98	0.00	0.00	10.11	56.46	72.99	8.24	7.54
20	0	550	636	0	0	1	37	32	27	20	0.50	0.50	0.00	0.00	11.27	72.99	94.18	7.54	6.75
21	1	636	978	0	2	0	37	27	25	21	0.00	0.00	0.00	0.00	0.00	94.18	149.51	6.75	6.54
22	1	978	563	2	0	0	35	25	30	22	0.00	0.00	0.81	1.19	0.00	149.51	77.98	6.54	7.22
23	1	563	694	0	5	0	35	30	25	23	0.00	0.00	0.00	0.00	0.00	77.98	108.62	7.22	6.39
24	0	694	391	5	0	2	32	25	20	24	0.64	1.36	2.01	2.99	-11.24	108.62	77.32	6.39	5.06
25	0	391	233	0	0	1	33	20	24	25	0.32	0.68	0.00	0.00	9.61	77.32	43.28	5.06	5.38
26	1	233	298	0	3	4	37	24	19	26	2.04	1.96	0.00	0.00	0.00	43.28	63.06	5.38	4.73
27	0	298	826	3	1	1	35	19	24	27	0.69	0.31	2.33	0.67	2.47	63.06	132.23	4.73	6.25
28	0	826	481	1	30	0	34	24	15	28	0.00	0.00	0.41	0.59	5.40	132.23	120.65	6.25	3.99
29	0	481	299	30	0	6	10	15	19	29	1.92	4.08	13.54	16.46	-71.54	120.65	63.25	3.99	4.73
30	1	299	187	0	0	3	13	19	13	30	0.99	2.01	0.00	0.00	0.00	63.25	56.30	4.73	3.32
31	0	187	277	0	0	1	14	13	12	31	0.51	0.49	0.00	0.00	1.72	56.30	87.27	3.32	3.17
32	0	277	212	0	0	0	14	12	14	32	0.00	0.00	0.00	0.00	3.37	87.27	59.38	3.17	3.57
33	1	212	1598	0	1	1	15	14	44	33	0.85	0.15	0.00	0.00	0.00	59.38	146.02	3.57	10.94

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1598	845	1	2	0	14	44	38	34	0.00	0.00	0.37	0.63	0.00	146.02	93.25	10.94	9.06
35	0	845	502	2	1	0	12	38	37	35	0.00	0.00	0.80	1.20	-1.52	93.25	61.69	9.06	8.14
36	0	502	1157	1	0	0	11	37	38	36	0.00	0.00	0.73	0.27	0.00	61.69	122.80	8.14	9.42
37	0	1157	827	0	0	0	11	38	45	37	0.00	0.00	0.00	0.00	0.00	122.80	81.79	9.42	10.11
38	0	827	571	0	1	0	11	45	38	38	0.00	0.00	0.00	0.00	5.93	81.79	67.29	10.11	8.49
39	1	571	1127	1	0	1	11	38	43	39	0.63	0.37	0.69	0.31	0.00	67.29	109.28	8.49	10.31
40	0	1127	624	0	0	1	12	43	43	40	0.33	0.67	0.00	0.00	0.00	109.28	67.17	10.31	9.29
41	0	624	407	0	0	0	12	43	35	41	0.00	0.00	0.00	0.00	6.08	67.17	54.02	9.29	7.53
42	0	407	1036	0	0	0	12	35	42	42	0.00	0.00	0.00	0.00	6.64	54.02	103.38	7.53	10.02
43	0	1036	760	0	1	0	12	42	39	43	0.00	0.00	0.00	0.00	0.00	103.38	83.70	10.02	9.08
44	0	760	1225	1	0	0	11	39	39	44	0.00	0.00	0.65	0.35	0.00	83.70	126.62	9.08	9.67
45	0	1225	628	0	1	0	11	39	40	45	0.00	0.00	0.00	0.00	0.00	126.62	70.41	9.67	8.92
46	0	628	1495	1	2	0	10	40	36	46	0.00	0.00	0.73	0.27	0.00	70.41	162.00	8.92	9.23
47	0	1495	501	2	1	0	8	36	42	47	0.00	0.00	0.55	1.45	0.00	162.00	57.53	9.23	8.71
48	0	501	1128	1	2	0	7	42	45	48	0.00	0.00	0.72	0.28	0.00	57.53	105.87	8.71	10.66
49	0	1128	632	2	0	0	5	45	43	49	0.00	0.00	0.77	1.23	0.00	105.87	67.84	10.66	9.32
50	0	632	708	0	1	0	5	43	20	50	0.00	0.00	0.00	0.00	1.84	67.84	134.38	9.32	5.27
51	1	708	420	1	1	0	4	20	25	51	0.00	0.00	0.42	0.58	0.00	134.38	69.16	5.27	6.07
52	0	420	1247	1	0	0	3	25	19	52	0.00	0.00	0.78	0.22	0.00	69.16	242.87	6.07	5.13
53	0	1247	542	0	0	0	3	19	40	53	0.00	0.00	0.00	0.00	0.00	242.87	62.67	5.13	8.65
54	0	542	2221	0	0	1	4	40	38	54	0.78	0.22	0.00	0.00	0.00	62.67	223.60	8.65	9.93
55	0	2221	764	0	2	0	4	38	43	55	0.00	0.00	0.00	0.00	0.00	223.60	78.89	9.93	9.68
56	0	764	937	2	0	0	2	43	43	56	0.00	0.00	1.16	0.84	0.00	78.89	93.38	9.68	10.03
57	0	937	398	0	0	0	2	43	39	57	0.00	0.00	0.00	0.00	1.09	93.38	50.28	10.03	7.92
58	0	398	724	0	0	0	2	39	42	58	0.00	0.00	0.00	0.00	1.13	50.28	76.64	7.92	9.45
59	0	724	1041	0	2	0	2	42	41	59	0.00	0.00	0.00	0.00	0.00	76.64	105.64	9.45	9.85
60	1	1041	0	2	0	0	0	41	0	60					0.00	105.64	0.00	9.85	0.00

Iteration 1: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13.351426	13	0	46.246	1					0.00	0.00	112.71	0.00	11.03
Consolidated	0	776	467	0	0	1	14	50	42	2	0.35	0.65	0.00	0.00	4.34	73.23	54.61	10.60	8.55
3	0	1243	1069	0	0	1.6485742	15	46.246	48	3	0.67	0.33	0.00	0.00	0.00	112.71	96.84	11.03	11.04
4	0	1069	1460	0	0	4	19	48	42	4	2.21	1.79	0.00	0.00	0.00	96.84	139.73	11.04	10.45
5	0	1460	632	0	0	0	19	42	50	5	0.00	0.00	0.00	0.00	0.00	139.73	62.87	10.45	10.05
6	0	632	1118	0	0	0	19	50	40	6	0.00	0.00	0.00	0.00	0.00	62.87	114.51	10.05	9.76
7	0	1118	1711	0	0	2	21	40	36	7	1.15	0.85	0.00	0.00	0.00	114.51	183.60	9.76	9.32
8	1	1711	1011	0	0	1	22	36	50	8	0.34	0.66	0.00	0.00	0.00	183.60	90.15	9.32	11.21
9	0	1011	861	0	0	1	23	50	50	9	0.44	0.56	0.00	0.00	0.00	90.15	79.35	11.21	10.85
10	0	861	1295	0	0	0	23	50	39.033	10	0.00	0.00	0.00	0.00	0.00	79.35	132.98	10.85	9.74
Consolidated	0	729	566	0	0	0	23	40	38	11	0.00	0.00	0.00	0.00	12.14	79.50	66.82	9.17	8.47
12	0	1295	1016	0	0	1	24	39.033	42.206	12	0.49	0.51	0.00	0.00	9.12	132.98	101.30	9.74	10.03
Consolidated	0	623	393	0	0	0	24	41	44	13	0.00	0.00	0.00	0.00	14.06	68.94	47.43	9.04	8.29
14	0	1016	909	0	0	3	27	42.206	45	14	2.01	0.99	0.00	0.00	4.13	101.30	88.35	10.03	10.29
15	1	909	1133	0	0	0.5066238	27	45	36.576	15	0.00	0.00	0.00	0.00	0.00	88.35	124.21	10.29	9.12
Consolidated	0	520	613	0	0	1	28	36	37	16	0.51	0.49	0.00	0.00	10.39	64.50	72.49	8.06	8.46
17	0	1133	795	0	0	5.5927493	32	36.576	40.122	17	1.28	2.72	0.00	0.00	6.12	124.21	85.20	9.12	9.33
Consolidated	0	330	465	0	0	2	34	43	39	18	1.10	0.90	0.00	0.00	12.76	42.56	56.46	7.75	8.24
19	0	795	1186	0	0	3.4000182	36	40.122	28.949	19	1.02	0.98	0.00	0.00	10.11	85.20	157.44	9.33	7.53
Consolidated	0	550	636	0	0	1	37	32	27	20	0.50	0.50	0.00	0.00	11.27	72.99	94.18	7.54	6.75
21	1	1186	978	0	2	0.5006086	37	28.949	25	21	0.00	0.00	0.00	0.00	0.00	157.44	149.51	7.53	6.54
22	1	978	563	2	0	0	35	25	30	22	0.00	0.00	0.81	1.19	0.00	149.51	77.98	6.54	7.22
23	1	563	694	0	5	0	35	30	25	23	0.00	0.00	0.00	0.00	0.00	77.98	108.62	7.22	6.39
24	0	694	624	5	0	2.3233773	32	25	21.357	24	0.64	1.36	2.01	2.99	-11.24	108.62	112.55	6.39	5.54
Consolidated	0	391	233	0	0	1	33	20	24	25	0.32	0.68	0.00	0.00	9.61	77.32	43.28	5.06	5.38
26	1	624	298	0	3	4.6766226	37	21.357	19	26	2.04	1.96	0.00	0.00	0.00	112.55	63.06	5.54	4.73
27	0	298	1307	3.4103835	1	1	35	19	19.555	27	0.69	0.31	2.33	0.67	2.47	63.06	247.05	4.73	5.29
Consolidated	0	826	481	1	30	0	34	24	15	28	0.00	0.00	0.41	0.59	5.40	132.23	120.65	6.25	3.99
29	0	1307	299	30.589616	0	6	10	19.555	19	29	1.92	4.08	13.54	16.46	-71.54	247.05	63.25	5.29	4.73
30	1	299	187	0	0	3	13	19	13	30	0.99	2.01	0.00	0.00	0.00	63.25	56.30	4.73	3.32
31	0	187	489	0	0	1	14	13	12.803	31	0.51	0.49	0.00	0.00	1.72	56.30	141.92	3.32	3.45
Consolidated	0	277	212	0	0	0	14	12	14	32	0.00	0.00	0.00	0.00	3.37	87.27	59.38	3.17	3.57
33	1	489	1598	0	1	1	15	12.803	44	33	0.85	0.15	0.00	0.00	0.00	141.92	146.02	3.45	10.94

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	0	1598	845	1	2	0	14	44	38	34	0.00	0.00	0.37	0.63	0.00	146.02	93.25	10.94	9.06
35	0	845	502	2	1	0	12	38	37	35	0.00	0.00	0.80	1.20	-1.52	93.25	61.69	9.06	8.14
36	0	502	1157	1	0	0	11	37	38	36	0.00	0.00	0.73	0.27	0.00	61.69	122.80	8.14	9.42
37	0	1157	1398	0	0	0	11	38	41.573	37	0.00	0.00	0.00	0.00	0.00	122.80	135.39	9.42	10.33
Consolidated	0	827	571	0	1	0	11	45	38	38	0.00	0.00	0.00	0.00	5.93	81.79	67.29	10.11	8.49
39	1	1398	1127	1	0	1	11	41.573	43	39	0.63	0.37	0.69	0.31	0.00	135.39	109.28	10.33	10.31
40	0	1127	624	0	0	1	12	43	43	40	0.33	0.67	0.00	0.00	0.00	109.28	67.17	10.31	9.29
41	0	624	1443	0	0	0	12	43	40.094	41	0.00	0.00	0.00	0.00	6.08	67.17	143.30	9.29	10.07
Consolidated	0	407	1036	0	0	0	12	35	42	42	0.00	0.00	0.00	0.00	6.64	54.02	103.38	7.53	10.02
43	0	1443	760	0	1	0	12	40.094	39	43	0.00	0.00	0.00	0.00	0.00	143.30	83.70	10.07	9.08
44	0	760	1225	1	0	0	11	39	39	44	0.00	0.00	0.65	0.35	0.00	83.70	126.62	9.08	9.67
45	0	1225	628	0	1	0	11	39	40	45	0.00	0.00	0.00	0.00	0.00	126.62	70.41	9.67	8.92
46	0	628	1495	1	2	0	10	40	36	46	0.00	0.00	0.73	0.27	0.00	70.41	162.00	8.92	9.23
47	0	1495	501	2	1	0	8	36	42	47	0.00	0.00	0.55	1.45	0.00	162.00	57.53	9.23	8.71
48	0	501	1128	1	2	0	7	42	45	48	0.00	0.00	0.72	0.28	0.00	57.53	105.87	8.71	10.66
49	0	1128	1340	2	0	0	5	45	25.642	49	0.00	0.00	0.77	1.23	0.00	105.87	193.68	10.66	6.92
Consolidated	0	632	708	0	1	0	5	43	20	50	0.00	0.00	0.00	0.00	1.84	67.84	134.38	9.32	5.27
51	1	1340	420	1	1	0	4	25.642	25	51	0.00	0.00	0.42	0.58	0.00	193.68	69.16	6.92	6.07
52	0	420	1247	1	0	0	3	25	19	52	0.00	0.00	0.78	0.22	0.00	69.16	242.87	6.07	5.13
53	0	1247	542	0	0	0	3	19	40	53	0.00	0.00	0.00	0.00	0.00	242.87	62.67	5.13	8.65
54	0	542	2221	0	0	1	4	40	38	54	0.78	0.22	0.00	0.00	0.00	62.67	223.60	8.65	9.93
55	0	2221	764	0	2	0	4	38	43	55	0.00	0.00	0.00	0.00	0.00	223.60	78.89	9.93	9.68
56	0	764	1335	2	0	0	2	43	41.646	56	0.00	0.00	1.16	0.84	0.00	78.89	129.84	9.68	10.28
Consolidated	0	937	398	0	0	0	2	43	39	57	0.00	0.00	0.00	0.00	1.09	93.38	50.28	10.03	7.92
58	0	1335	724	0	0	0	2	41.646	42	58	0.00	0.00	0.00	0.00	1.13	129.84	76.64	10.28	9.45
59	0	724	1041	0	2	0	2	42	41	59	0.00	0.00	0.00	0.00	0.00	76.64	105.64	9.45	9.85
60	1	1041	0	2	0	0	0	41	0	60					0.00	105.64	0.00	9.85	0.00

Final Update in iteration 1 or Primary Data Table for iteration 2

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13	13	0	46	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	1243	1069	0	0	2	15	46	48	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	1069	1460	0	0	4	19	48	42	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	1460	632	0	0	0	19	42	50	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	632	1118	0	0	0	19	50	40	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	1118	1711	0	0	2	21	40	36	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1	1711	1011	0	0	1	22	36	50	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0	1011	861	0	0	1	23	50	50	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	861	1295	0	0	0	23	50	39	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	1295	1016	0	0	1	24	39	42	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	1016	909	0	0	3	27	42	45	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1	909	1133	0	0	1	28	45	37	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	1133	795	0	0	6	34	37	40	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	795	1186	0	0	3	37	40	29	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	1	1186	978	0	2	1	38	29	25	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	1	978	563	2	0	0	36	25	30	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	1	563	694	0	5	0	36	30	25	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0	694	624	5	0	2	33	25	21	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	1	624	298	0	3	5	38	21	19	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0	298	1307	3	31	1	36	19	20	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0	1307	299	31	0	6	11	20	19	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1	299	187	0	0	3	14	19	13	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0	187	489	0	0	1	15	13	13	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	1	489	1598	0	1	1	16	13	44	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0	1598	845	1	2	0	15	44	38	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0	845	502	2	1	0	13	38	37	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0	502	1157	1	0	0	12	37	38	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0	1157	1398	0	1	0	12	38	42	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	1	1398	1127	1	0	1	12	42	43	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0	1127	624	0	0	1	13	43	43	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0	624	1443	0	0	0	13	43	40	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0	1443	760	0	1	0	13	40	39	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0	760	1225	1	0	0	12	39	39	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
45	0	1225	628	0	1	0	12	39	40	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0	628	1495	1	2	0	11	40	36	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0	1495	501	2	1	0	9	36	42	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0	501	1128	1	2	0	8	42	45	37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0	1128	1340	2	1	0	6	45	26	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	1	1340	420	1	1	0	5	26	25	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0	420	1247	1	0	0	4	25	19	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0	1247	542	0	0	0	4	19	40	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0	542	2221	0	0	1	5	40	38	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0	2221	764	0	2	0	5	38	43	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0	764	1335	2	0	0	3	43	42	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0	1335	724	0	0	0	3	42	42	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	0	724	1041	0	2	0	3	42	41	46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	1	1041	0	3	0	0	0	41	0	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 2: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13	13	0	46	1	0.00	0.00	0.00	0.00	0.00	0.00	113.25	0.00	10.98
3	0	1243	1069	0	0	2	15	46	48	2	0.87	1.13	0.00	0.00	0.00	113.25	96.84	10.98	11.04
4	0	1069	1460	0	0	4	19	48	42	3	2.21	1.79	0.00	0.00	0.00	96.84	139.73	11.04	10.45
5	0	1460	632	0	0	0	19	42	50	4	0.00	0.00	0.00	0.00	0.00	139.73	62.87	10.45	10.05
6	0	632	1118	0	0	0	19	50	40	5	0.00	0.00	0.00	0.00	0.00	62.87	114.51	10.05	9.76
7	0	1118	1711	0	0	2	21	40	36	6	1.15	0.85	0.00	0.00	0.00	114.51	183.60	9.76	9.32
8	1	1711	1011	0	0	1	22	36	50	7	0.34	0.66	0.00	0.00	0.00	183.60	90.15	9.32	11.21
9	0	1011	861	0	0	1	23	50	50	8	0.44	0.56	0.00	0.00	0.00	90.15	79.35	11.21	10.85
10	0	861	1295	0	0	0	23	50	39	9	0.00	0.00	0.00	0.00	0.00	79.35	133.08	10.85	9.73
12	0	1295	1016	0	0	1	24	39	42	10	0.41	0.59	0.00	0.00	0.00	133.08	101.67	9.73	9.99
14	0	1016	909	0	0	3	27	42	45	11	1.33	1.67	0.00	0.00	0.00	101.67	88.35	9.99	10.29
15	1	909	1133	0	0	1	28	45	37	12	0.53	0.47	0.00	0.00	0.00	88.35	123.09	10.29	9.21
17	0	1133	795	0	0	6	34	37	40	13	2.30	3.70	0.00	0.00	0.00	123.09	85.44	9.21	9.30
19	0	795	1186	0	0	3	37	40	29	14	1.71	1.29	0.00	0.00	0.00	85.44	157.30	9.30	7.54
21	1	1186	978	0	2	1	38	29	25	15	0.42	0.58	0.00	0.00	0.00	157.30	149.51	7.54	6.54
22	1	978	563	2	0	0	36	25	30	16	0.00	0.00	0.81	1.19	0.00	149.51	77.98	6.54	7.22
23	1	563	694	0	5	0	36	30	25	17	0.00	0.00	0.00	0.00	0.00	77.98	108.62	7.22	6.39
24	0	694	624	5	0	2	33	25	21	18	0.86	1.14	2.58	2.42	-16.77	108.62	114.26	6.39	5.46
26	1	624	298	0	3	5	38	21	19	19	1.40	3.60	0.00	0.00	0.00	114.26	63.06	5.46	4.73
27	0	298	1307	3	31	1	36	19	20	20	0.78	0.22	2.54	0.46	0.00	63.06	242.20	4.73	5.40
29	0	1307	299	31	0	6	11	20	19	21	0.94	5.06	6.81	24.19	0.00	242.20	63.25	5.40	4.73
30	1	299	187	0	0	3	14	19	13	22	0.99	2.01	0.00	0.00	0.00	63.25	56.30	4.73	3.32
31	0	187	489	0	0	1	15	13	13	23	0.65	0.35	0.00	0.00	1.67	56.30	139.93	3.32	3.49
33	1	489	1598	0	1	1	16	13	44	24	0.70	0.30	0.00	0.00	0.00	139.93	146.02	3.49	10.94
34	0	1598	845	1	2	0	15	44	38	25	0.00	0.00	0.37	0.63	0.00	146.02	93.25	10.94	9.06
35	0	845	502	2	1	0	13	38	37	26	0.00	0.00	0.80	1.20	-1.01	93.25	61.69	9.06	8.14
36	0	502	1157	1	0	0	12	37	38	27	0.00	0.00	0.73	0.27	0.00	61.69	122.80	8.14	9.42
37	0	1157	1398	0	1	0	12	38	42	28	0.00	0.00	0.00	0.00	0.00	122.80	134.41	9.42	10.40
39	1	1398	1127	1	0	1	12	42	43	29	0.42	0.58	0.47	0.53	0.00	134.41	109.28	10.40	10.31
40	0	1127	624	0	0	1	13	43	43	30	0.33	0.67	0.00	0.00	0.00	109.28	67.17	10.31	9.29
41	0	624	1443	0	0	0	13	43	40	31	0.00	0.00	0.00	0.00	0.00	67.17	143.76	9.29	10.04
43	0	1443	760	0	1	0	13	40	39	32	0.00	0.00	0.00	0.00	0.00	143.76	83.70	10.04	9.08
44	0	760	1225	1	0	0	12	39	39	33	0.00	0.00	0.65	0.35	0.00	83.70	126.62	9.08	9.67

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
45	0	1225	628	0	1	0	12	39	40	34	0.00	0.00	0.00	0.00	0.00	126.62	70.41	9.67	8.92
46	0	628	1495	1	2	0	11	40	36	35	0.00	0.00	0.73	0.27	0.00	70.41	162.00	8.92	9.23
47	0	1495	501	2	1	0	9	36	42	36	0.00	0.00	0.55	1.45	0.00	162.00	57.53	9.23	8.71
48	0	501	1128	1	2	0	8	42	45	37	0.00	0.00	0.72	0.28	0.00	57.53	105.87	8.71	10.66
49	0	1128	1340	2	1	0	6	45	26	38	0.00	0.00	1.14	0.86	0.00	105.87	194.57	10.66	6.89
51	1	1340	420	1	1	0	5	26	25	39	0.00	0.00	0.27	0.73	0.00	194.57	69.16	6.89	6.07
52	0	420	1247	1	0	0	4	25	19	40	0.00	0.00	0.78	0.22	0.00	69.16	242.87	6.07	5.13
53	0	1247	542	0	0	0	4	19	40	41	0.00	0.00	0.00	0.00	0.00	242.87	62.67	5.13	8.65
54	0	542	2221	0	0	1	5	40	38	42	0.78	0.22	0.00	0.00	0.00	62.67	223.60	8.65	9.93
55	0	2221	764	0	2	0	5	38	43	43	0.00	0.00	0.00	0.00	0.00	223.60	78.89	9.93	9.68
56	0	764	1335	2	0	0	3	43	42	44	0.00	0.00	1.32	0.68	0.00	78.89	129.01	9.68	10.35
58	0	1335	724	0	0	0	3	42	42	45	0.00	0.00	0.00	0.00	0.00	129.01	76.64	10.35	9.45
59	0	724	1041	0	2	0	3	42	41	46	0.00	0.00	0.00	0.00	0.00	76.64	105.64	9.45	9.85
60	1	1041	0	3	0	0	0	41	0	47	0.00	0.00	0.00	0.00	0.00	105.64	0.00	9.85	0.00

Iteration 2: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13	13	0	46	1	0.00	0.00	0.00	0.00	0.00	0.00	113.25	0.00	10.98
3	0	1243	1069	0	0	2	15	46	48	2	0.87	1.13	0.00	0.00	0.00	113.25	96.84	10.98	11.04
4	0	1069	1460	0	0	4	19	48	42	3	2.21	1.79	0.00	0.00	0.00	96.84	139.73	11.04	10.45
5	0	1460	632	0	0	0	19	42	50	4	0.00	0.00	0.00	0.00	0.00	139.73	62.87	10.45	10.05
6	0	632	1118	0	0	0	19	50	40	5	0.00	0.00	0.00	0.00	0.00	62.87	114.51	10.05	9.76
7	0	1118	1711	0	0	2	21	40	36	6	1.15	0.85	0.00	0.00	0.00	114.51	183.60	9.76	9.32
8	1	1711	1011	0	0	1	22	36	50	7	0.34	0.66	0.00	0.00	0.00	183.60	90.15	9.32	11.21
9	0	1011	861	0	0	1	23	50	50	8	0.44	0.56	0.00	0.00	0.00	90.15	79.35	11.21	10.85
10	0	861	1295	0	0	0	23	50	39	9	0.00	0.00	0.00	0.00	0.00	79.35	133.08	10.85	9.73
12	0	1295	1016	0	0	1	24	39	42	10	0.41	0.59	0.00	0.00	0.00	133.08	101.67	9.73	9.99
14	0	1016	909	0	0	3	27	42	45	11	1.33	1.67	0.00	0.00	0.00	101.67	88.35	9.99	10.29
15	1	909	1133	0	0	1	28	45	37	12	0.53	0.47	0.00	0.00	0.00	88.35	123.09	10.29	9.21
17	0	1133	795	0	0	6	34	37	40	13	2.30	3.70	0.00	0.00	0.00	123.09	85.44	9.21	9.30
19	0	795	1186	0	0	3	37	40	29	14	1.71	1.29	0.00	0.00	0.00	85.44	157.30	9.30	7.54
21	1	1186	978	0	2	1	38	29	25	15	0.42	0.58	0.00	0.00	0.00	157.30	149.51	7.54	6.54
22	1	978	563	2	0	0	36	25	30	16	0.00	0.00	0.81	1.19	0.00	149.51	77.98	6.54	7.22
23	1	563	694	0	5	0	36	30	25	17	0.00	0.00	0.00	0.00	0.00	77.98	108.62	7.22	6.39
24	0	694	624	5	0	2	33	25	21	18	0.86	1.14	2.58	2.42	-16.77	108.62	114.26	6.39	5.46
26	1	624	298	0	3	5	38	21	19	19	1.40	3.60	0.00	0.00	0.00	114.26	63.06	5.46	4.73
27	0	298	1307	3	31	1	36	19	20	20	0.78	0.22	2.54	0.46	0.00	63.06	242.20	4.73	5.40
29	0	1307	299	31	0	6	11	20	19	21	0.94	5.06	6.81	24.19	0.00	242.20	63.25	5.40	4.73
30	1	299	676	0	0	3.651	14	19	13	22	0.99	2.01	0.00	0.00	0.00	63.25	191.71	4.73	3.53
Consolidated	0	187	489	0	0	1	15	13	13	23	0.65	0.35	0.00	0.00	1.67	56.30	139.93	3.32	3.49
33	1	676	1598	0	1	1.349	16	13	44	24	0.70	0.30	0.00	0.00	0.00	191.71	146.02	3.53	10.94
34	0	1598	845	1	2	0	15	44	38	25	0.00	0.00	0.37	0.63	0.00	146.02	93.25	10.94	9.06
35	0	845	502	2	1	0	13	38	37	26	0.00	0.00	0.80	1.20	-1.01	93.25	61.69	9.06	8.14
36	0	502	1157	1	0	0	12	37	38	27	0.00	0.00	0.73	0.27	0.00	61.69	122.80	8.14	9.42
37	0	1157	1398	0	1	0	12	38	42	28	0.00	0.00	0.00	0.00	0.00	122.80	134.41	9.42	10.40
39	1	1398	1127	1	0	1	12	42	43	29	0.42	0.58	0.47	0.53	0.00	134.41	109.28	10.40	10.31
40	0	1127	624	0	0	1	13	43	43	30	0.33	0.67	0.00	0.00	0.00	109.28	67.17	10.31	9.29
41	0	624	1443	0	0	0	13	43	40	31	0.00	0.00	0.00	0.00	0.00	67.17	143.76	9.29	10.04
43	0	1443	760	0	1	0	13	40	39	32	0.00	0.00	0.00	0.00	0.00	143.76	83.70	10.04	9.08
44	0	760	1225	1	0	0	12	39	39	33	0.00	0.00	0.65	0.35	0.00	83.70	126.62	9.08	9.67

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
45	0	1225	628	0	1	0	12	39	40	34	0.00	0.00	0.00	0.00	0.00	126.62	70.41	9.67	8.92
46	0	628	1495	1	2	0	11	40	36	35	0.00	0.00	0.73	0.27	0.00	70.41	162.00	8.92	9.23
47	0	1495	501	2	1	0	9	36	42	36	0.00	0.00	0.55	1.45	0.00	162.00	57.53	9.23	8.71
48	0	501	1128	1	2	0	8	42	45	37	0.00	0.00	0.72	0.28	0.00	57.53	105.87	8.71	10.66
49	0	1128	1340	2	1	0	6	45	26	38	0.00	0.00	1.14	0.86	0.00	105.87	194.57	10.66	6.89
51	1	1340	420	1	1	0	5	26	25	39	0.00	0.00	0.27	0.73	0.00	194.57	69.16	6.89	6.07
52	0	420	1247	1	0	0	4	25	19	40	0.00	0.00	0.78	0.22	0.00	69.16	242.87	6.07	5.13
53	0	1247	542	0	0	0	4	19	40	41	0.00	0.00	0.00	0.00	0.00	242.87	62.67	5.13	8.65
54	0	542	2221	0	0	1	5	40	38	42	0.78	0.22	0.00	0.00	0.00	62.67	223.60	8.65	9.93
55	0	2221	764	0	2	0	5	38	43	43	0.00	0.00	0.00	0.00	0.00	223.60	78.89	9.93	9.68
56	0	764	1335	2	0	0	3	43	42	44	0.00	0.00	1.32	0.68	0.00	78.89	129.01	9.68	10.35
58	0	1335	724	0	0	0	3	42	42	45	0.00	0.00	0.00	0.00	0.00	129.01	76.64	10.35	9.45
59	0	724	1041	0	2	0	3	42	41	46	0.00	0.00	0.00	0.00	0.00	76.64	105.64	9.45	9.85
60	1	1041	0	3	0	0	0	41	0	47	0.00	0.00	0.00	0.00	0.00	105.64	0.00	9.85	0.00

Final Update in Iteration 2 or Primary Data Table for Iteration 3

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13	13	0	46	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	1243	1069	0	0	2	15	46	48	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	1069	1460	0	0	4	19	48	42	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	1460	632	0	0	0	19	42	50	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	632	1118	0	0	0	19	50	40	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	1118	1711	0	0	2	21	40	36	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1	1711	1011	0	0	1	22	36	50	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0	1011	861	0	0	1	23	50	50	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	861	1295	0	0	0	23	50	39	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	1295	1016	0	0	1	24	39	42	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	1016	909	0	0	3	27	42	45	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1	909	1133	0	0	1	28	45	37	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	1133	795	0	0	6	34	37	40	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	795	1186	0	0	3	37	40	29	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	1	1186	978	0	2	1	38	29	25	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	1	978	563	2	0	0	36	25	30	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	1	563	694	0	5	0	36	30	25	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0	694	624	5	0	2	33	25	21	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	1	624	298	0	3	5	38	21	19	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0	298	1307	3	31	1	36	19	20	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0	1307	299	31	0	6	11	20	19	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1	299	676	0	0	4	15	19	13	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	1	676	1598	0	1	1	16	13	44	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0	1598	845	1	2	0	15	44	38	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0	845	502	2	1	0	13	38	37	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0	502	1157	1	0	0	12	37	38	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0	1157	1398	0	1	0	12	38	42	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	1	1398	1127	1	0	1	12	42	43	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0	1127	624	0	0	1	13	43	43	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0	624	1443	0	0	0	13	43	40	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0	1443	760	0	1	0	13	40	39	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0	760	1225	1	0	0	12	39	39	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0	1225	628	0	1	0	12	39	40	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
46	0	628	1495	1	2	0	11	40	36	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0	1495	501	2	1	0	9	36	42	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0	501	1128	1	2	0	8	42	45	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0	1128	1340	2	1	0	6	45	26	37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	1	1340	420	1	1	0	5	26	25	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0	420	1247	1	0	0	4	25	19	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0	1247	542	0	0	0	4	19	40	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0	542	2221	0	0	1	5	40	38	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0	2221	764	0	2	0	5	38	43	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0	764	1335	2	0	0	3	43	42	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0	1335	724	0	0	0	3	42	42	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	0	724	1041	0	3	0	3	42	41	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	1	1041	0	3	0	0	0	41	0	46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 3: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1243	0	0	13	13	0	46	1	0.00	0.00	0.00	0.00	0.00	0.00	113.25	0.00	10.98
3	0	1243	1069	0	0	2	15	46	48	2	0.87	1.13	0.00	0.00	0.00	113.25	96.84	10.98	11.04
4	0	1069	1460	0	0	4	19	48	42	3	2.21	1.79	0.00	0.00	0.00	96.84	139.73	11.04	10.45
5	0	1460	632	0	0	0	19	42	50	4	0.00	0.00	0.00	0.00	0.00	139.73	62.87	10.45	10.05
6	0	632	1118	0	0	0	19	50	40	5	0.00	0.00	0.00	0.00	0.00	62.87	114.51	10.05	9.76
7	0	1118	1711	0	0	2	21	40	36	6	1.15	0.85	0.00	0.00	0.00	114.51	183.60	9.76	9.32
8	1	1711	1011	0	0	1	22	36	50	7	0.34	0.66	0.00	0.00	0.00	183.60	90.15	9.32	11.21
9	0	1011	861	0	0	1	23	50	50	8	0.44	0.56	0.00	0.00	0.00	90.15	79.35	11.21	10.85
10	0	861	1295	0	0	0	23	50	39	9	0.00	0.00	0.00	0.00	0.00	79.35	133.08	10.85	9.73
12	0	1295	1016	0	0	1	24	39	42	10	0.41	0.59	0.00	0.00	0.00	133.08	101.67	9.73	9.99
14	0	1016	909	0	0	3	27	42	45	11	1.33	1.67	0.00	0.00	0.00	101.67	88.35	9.99	10.29
15	1	909	1133	0	0	1	28	45	37	12	0.53	0.47	0.00	0.00	0.00	88.35	123.09	10.29	9.21
17	0	1133	795	0	0	6	34	37	40	13	2.30	3.70	0.00	0.00	0.00	123.09	85.44	9.21	9.30
19	0	795	1186	0	0	3	37	40	29	14	1.71	1.29	0.00	0.00	0.00	85.44	157.30	9.30	7.54
21	1	1186	978	0	2	1	38	29	25	15	0.42	0.58	0.00	0.00	0.00	157.30	149.51	7.54	6.54
22	1	978	563	2	0	0	36	25	30	16	0.00	0.00	0.81	1.19	0.00	149.51	77.98	6.54	7.22
23	1	563	694	0	5	0	36	30	25	17	0.00	0.00	0.00	0.00	0.00	77.98	108.62	7.22	6.39
24	0	694	624	5	0	2	33	25	21	18	0.86	1.14	2.58	2.42	-16.77	108.62	114.26	6.39	5.46
26	1	624	298	0	3	5	38	21	19	19	1.40	3.60	0.00	0.00	0.00	114.26	63.06	5.46	4.73
27	0	298	1307	3	31	1	36	19	20	20	0.78	0.22	2.54	0.46	0.00	63.06	242.20	4.73	5.40
29	0	1307	299	31	0	6	11	20	19	21	0.94	5.06	6.81	24.19	0.00	242.20	63.25	5.40	4.73
30	1	299	676	0	0	4	15	19	13	22	2.56	1.44	0.00	0.00	0.00	63.25	191.71	4.73	3.53
33	1	676	1598	0	1	1	16	13	44	23	0.63	0.37	0.00	0.00	0.00	191.71	146.02	3.53	10.94
34	0	1598	845	1	2	0	15	44	38	24	0.00	0.00	0.37	0.63	0.00	146.02	93.25	10.94	9.06
35	0	845	502	2	1	0	13	38	37	25	0.00	0.00	0.80	1.20	-1.01	93.25	61.69	9.06	8.14
36	0	502	1157	1	0	0	12	37	38	26	0.00	0.00	0.73	0.27	0.00	61.69	122.80	8.14	9.42
37	0	1157	1398	0	1	0	12	38	42	27	0.00	0.00	0.00	0.00	0.00	122.80	134.41	9.42	10.40
39	1	1398	1127	1	0	1	12	42	43	28	0.42	0.58	0.47	0.53	0.00	134.41	109.28	10.40	10.31
40	0	1127	624	0	0	1	13	43	43	29	0.33	0.67	0.00	0.00	0.00	109.28	67.17	10.31	9.29
41	0	624	1443	0	0	0	13	43	40	30	0.00	0.00	0.00	0.00	0.00	67.17	143.76	9.29	10.04
43	0	1443	760	0	1	0	13	40	39	31	0.00	0.00	0.00	0.00	0.00	143.76	83.70	10.04	9.08
44	0	760	1225	1	0	0	12	39	39	32	0.00	0.00	0.65	0.35	0.00	83.70	126.62	9.08	9.67
45	0	1225	628	0	1	0	12	39	40	33	0.00	0.00	0.00	0.00	0.00	126.62	70.41	9.67	8.92

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
46	0	628	1495	1	2	0	11	40	36	34	0.00	0.00	0.73	0.27	0.00	70.41	162.00	8.92	9.23
47	0	1495	501	2	1	0	9	36	42	35	0.00	0.00	0.55	1.45	0.00	162.00	57.53	9.23	8.71
48	0	501	1128	1	2	0	8	42	45	36	0.00	0.00	0.72	0.28	0.00	57.53	105.87	8.71	10.66
49	0	1128	1340	2	1	0	6	45	26	37	0.00	0.00	1.14	0.86	0.00	105.87	194.57	10.66	6.89
51	1	1340	420	1	1	0	5	26	25	38	0.00	0.00	0.27	0.73	0.00	194.57	69.16	6.89	6.07
52	0	420	1247	1	0	0	4	25	19	39	0.00	0.00	0.78	0.22	0.00	69.16	242.87	6.07	5.13
53	0	1247	542	0	0	0	4	19	40	40	0.00	0.00	0.00	0.00	0.00	242.87	62.67	5.13	8.65
54	0	542	2221	0	0	1	5	40	38	41	0.78	0.22	0.00	0.00	0.00	62.67	223.60	8.65	9.93
55	0	2221	764	0	2	0	5	38	43	42	0.00	0.00	0.00	0.00	0.00	223.60	78.89	9.93	9.68
56	0	764	1335	2	0	0	3	43	42	43	0.00	0.00	1.32	0.68	0.00	78.89	129.01	9.68	10.35
58	0	1335	724	0	0	0	3	42	42	44	0.00	0.00	0.00	0.00	0.00	129.01	76.64	10.35	9.45
59	0	724	1041	0	3	0	3	42	41	45	0.00	0.00	0.00	0.00	0.00	76.64	105.64	9.45	9.85
60	1	1041	0	3	0	0	0	41	0	46	0.00	0.00	0.00	0.00	0.00	105.64	0.00	9.85	0.00

Primary Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1									
2	0	1014	805	0	0	0	1	35	43	2									
3	0	805	393	0	0	2	3	43	37	3									
4	0	393	948	0	0	0	3	37	37	4									
5	0	948	755	0	0	0	3	37	37	5									
6	0	755	914	0	0	0	3	37	40	6									
7	0	914	1281	0	0	0	3	40	43	7									
8	0	1281	565	0	0	1	4	43	40	8									
9	0	565	829	0	0	0	4	40	19	9									
10	0	829	414	0	0	3	7	19	18	10									
11	0	414	1072	0	2	3	10	18	23	11									
12	0	1072	674	2	0	0	8	23	40	12									
13	0	674	534	0	0	0	8	40	42	13									
14	0	534	1070	0	0	0	8	42	41	14									
15	0	1070	369	0	0	0	8	41	37	15									
16	0	369	1160	0	0	0	8	37	36	16									
17	0	1160	705	0	0	3	11	36	42	17									
18	0	705	1154	0	0	0	11	42	41	18									
19	0	1154	732	0	0	0	11	41	36	19									
20	0	732	288	0	0	0	11	36	43	20									
21	0	288	781	0	0	0	11	43	42	21									
22	0	781	491	0	0	0	11	42	40	22									
23	0	491	465	0	0	0	11	40	38	23									
24	0	465	571	0	0	1	12	38	43	24									
25	1	571	681	0	1	1	13	43	39	25									
26	0	681	433	1	0	3	15	39	44	26									
27	0	433	864	0	0	0	15	44	36	27									
28	0	864	1110	0	1	0	15	36	43	28									
29	0	1110	608	1	1	0	14	43	40	29									
30	0	608	375	1	3	0	13	40	45	30									
31	0	375	394	3	0	3	13	45	40	31									
32	0	394	740	0	0	1	14	40	45	32									
33	0	740	600	0	2	2	16	45	12	33									

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	1	600	249	2	0	2	16	12	19	34									
35	0	249	166	0	0	0	16	19	14	35									
36	0	166	298	0	1	4	20	14	19	36									
37	0	298	156	1	0	0	19	19	13	37									
38	1	156	357	0	6	1	20	13	20	38									
39	1	357	1605	6	1	14	28	20	24	39									
40	0	1605	203	1	0	1	28	24	16	40									
41	0	203	425	0	0	0	28	16	19	41									
42	0	425	544	0	0	0	28	19	23	42									
43	0	544	634	0	1	1	29	23	37	43									
44	1	634	1046	1	0	4	32	37	42	44									
45	0	1046	549	0	0	0	32	42	42	45									
46	0	549	1117	0	1	0	32	42	40	46									
47	0	1117	196	1	5	0	31	40	48	47									
48	0	196	678	5	3	4	30	48	47	48									
49	0	678	463	3	2	0	27	47	40	49									
50	0	463	848	2	2	0	25	40	35	50									
51	0	848	597	2	4	0	23	35	44	51									
52	0	597	451	4	1	0	19	44	49	52									
53	0	451	737	1	2	0	18	49	36	53									
54	0	737	301	2	0	0	16	36	36	54									
55	0	301	394	0	0	0	16	36	38	55									
56	0	394	864	0	0	0	16	38	38	56									
57	0	864	286	0	0	0	16	38	36	57									
58	0	286	681	0	1	0	16	36	37	58									
59	0	681	1841	1	5	0	15	37	47	59									
60	0	1841	946	5	0	0	10	47	43	60									
61	0	946	798	0	1	0	10	43	38	61									
62	0	798	1477	1	0	0	9	38	43	62									
63	0	1477	982	0	4	0	9	43	43	63									
64	0	982	398	4	0	0	5	43	38	64									
65	0	398	739	0	5	0	5	38	43	65									
66	1	739	0	5	0	0	0	43	0	66									

Iteration 1: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1					0.00	0.00	116.45	0.00	8.71
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	116.45	82.33	8.71	9.78
3	0	805	393	0	0	2	3	43	37	3	0.61	1.39	0.00	0.00	-5.36	82.33	51.09	9.78	7.69
4	0	393	948	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	1.53	51.09	105.09	7.69	9.02
5	0	948	755	0	0	0	3	37	37	5	0.00	0.00	0.00	0.00	0.00	105.09	86.31	9.02	8.75
6	0	755	914	0	0	0	3	37	40	6	0.00	0.00	0.00	0.00	0.00	86.31	96.15	8.75	9.51
7	0	914	1281	0	0	0	3	40	43	7	0.00	0.00	0.00	0.00	0.00	96.15	122.18	9.51	10.48
8	0	1281	565	0	0	1	4	43	40	8	0.28	0.72	0.00	0.00	0.00	122.18	64.74	10.48	8.73
9	0	565	829	0	0	0	4	40	19	9	0.00	0.00	0.00	0.00	1.41	64.74	163.67	8.73	5.07
10	0	829	414	0	0	3	7	19	18	10	0.86	2.14	0.00	0.00	-7.69	163.67	89.05	5.07	4.65
11	0	414	1072	0	2	3	10	18	23	11	2.01	0.99	0.00	0.00	0.00	89.05	175.78	4.65	6.10
12	0	1072	674	2	0	0	8	23	40	12	0.00	0.00	0.86	1.14	0.00	175.78	74.55	6.10	9.04
13	0	674	534	0	0	0	8	40	42	13	0.00	0.00	0.00	0.00	4.52	74.55	60.35	9.04	8.85
14	0	534	1070	0	0	0	8	42	41	14	0.00	0.00	0.00	0.00	0.00	60.35	108.19	8.85	9.89
15	0	1070	369	0	0	0	8	41	37	15	0.00	0.00	0.00	0.00	4.17	108.19	48.75	9.89	7.57
16	0	369	1160	0	0	0	8	37	36	16	0.00	0.00	0.00	0.00	0.00	48.75	128.50	7.57	9.03
17	0	1160	705	0	0	3	11	36	42	17	1.05	1.95	0.00	0.00	0.00	128.50	75.01	9.03	9.40
18	0	705	1154	0	0	0	11	42	41	18	0.00	0.00	0.00	0.00	0.00	75.01	115.56	9.40	9.99
19	0	1154	732	0	0	0	11	41	36	19	0.00	0.00	0.00	0.00	0.00	115.56	85.70	9.99	8.54
20	0	732	288	0	0	0	11	36	43	20	0.00	0.00	0.00	0.00	6.21	85.70	39.04	8.54	7.38
21	0	288	781	0	0	0	11	43	42	21	0.00	0.00	0.00	0.00	6.29	39.04	81.53	7.38	9.58
22	0	781	491	0	0	0	11	42	40	22	0.00	0.00	0.00	0.00	6.06	81.53	58.08	9.58	8.45
23	0	491	465	0	0	0	11	40	38	23	0.00	0.00	0.00	0.00	5.81	58.08	57.25	8.45	8.12
24	0	465	571	0	0	1	12	38	43	24	0.52	0.48	0.00	0.00	3.16	57.25	62.74	8.12	9.10
25	1	571	681	0	1	1	13	43	39	25	0.51	0.49	0.00	0.00	0.00	62.74	76.40	9.10	8.91
26	0	681	433	1	0	3	15	39	44	26	1.08	1.92	0.42	0.58	-5.40	76.40	50.71	8.91	8.54
27	0	433	864	0	0	0	15	44	36	27	0.00	0.00	0.00	0.00	7.78	50.71	98.90	8.54	8.74
28	0	864	1110	0	1	0	15	36	43	28	0.00	0.00	0.00	0.00	0.00	98.90	107.86	8.74	10.29
29	0	1110	608	1	1	0	14	43	40	29	0.00	0.00	0.38	0.62	0.00	107.86	68.61	10.29	8.86
30	0	608	375	1	3	0	13	40	45	30	0.00	0.00	0.41	0.59	4.89	68.61	45.63	8.86	8.22
31	0	375	394	3	0	3	13	45	40	31	1.44	1.56	1.64	1.36	-8.00	45.63	49.35	8.22	7.98
32	0	394	740	0	0	1	14	40	45	32	0.62	0.38	0.00	0.00	4.50	49.35	74.83	7.98	9.89
33	0	740	600	0	2	2	16	45	12	33	0.84	1.16	0.00	0.00	-1.10	74.83	184.17	9.89	3.26

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	1	600	249	2	0	2	16	12	19	34	0 45	1.55	0.74	1.26	0.00	184.17	53.78	3.26	4.63
35	0	249	166	0	0	0	16	19	14	35	0.00	0.00	0.00	0.00	4.11	53.78	47.55	4.63	3.49
36	0	166	298	0	1	4	20	14	19	36	2.26	1.74	0.00	0.00	-0.69	47.55	63.06	3.49	4.73
37	0	298	156	1	0	0	19	19	13	37	0.00	0.00	0.40	0.60	3.35	63.06	47.71	4.73	3.27
38	1	156	357	0	6	1	20	13	20	38	0.62	0.38	0.00	0.00	0.00	47.71	71.20	3.27	5.01
39	1	357	1605	6	1	14	28	20	24	39	10.96	3.04	5.09	0.91	0.00	71.20	249.08	5.01	6.44
40	0	1605	203	1	0	1	28	24	16	40	0.10	0.90	0.13	0.87	0.00	249.08	51.23	6.44	3.96
41	0	203	425	0	0	0	28	16	19	41	0.00	0.00	0.00	0.00	8.30	51.23	87.12	3.96	4.88
42	0	425	544	0	0	0	28	19	23	42	0.00	0.00	0.00	0.00	9.53	87.12	93.13	4.88	5.84
43	0	544	634	0	1	1	29	23	37	43	0.49	0.51	0.00	0.00	9.75	93.13	74.53	5.84	8.51
44	1	634	1046	1	0	4	32	37	42	44	2.37	1.63	0.65	0.35	0.00	74.53	104.24	8.51	10.03
45	0	1046	549	0	0	0	32	42	42	45	0.00	0.00	0.00	0.00	0.00	104.24	61.64	10.03	8.91
46	0	549	1117	0	1	0	32	42	40	46	0.00	0.00	0.00	0.00	0.00	61.64	114.42	8.91	9.76
47	0	1117	196	1	5	0	31	40	48	47	0.00	0.00	0.16	0.84	17.02	114.42	31.37	9.76	6.25
48	0	196	678	5	3	4	30	48	47	48	2.97	1.03	4.03	0.97	0.66	31.37	68.25	6.25	9.93
49	0	678	463	3	2	0	27	47	40	49	0.00	0.00	1.30	1.70	5.05	68.25	55.56	9.93	8.33
50	0	463	848	2	2	0	25	40	35	50	0.00	0.00	1.35	0.65	5.60	55.56	99.38	8.33	8.53
51	0	848	597	2	4	0	23	35	44	51	0.00	0.00	0.89	1.11	4.90	99.38	64.12	8.53	9.31
52	0	597	451	4	1	0	19	44	49	52	0.00	0.00	1.84	2.16	-0.18	64.12	50.15	9.31	8.99
53	0	451	737	1	2	0	18	49	36	53	0.00	0.00	0.65	0.35	6.26	50.15	86.20	8.99	8.55
54	0	737	301	2	0	0	16	36	36	54	0.00	0.00	0.63	1.37	2.65	86.20	42.60	8.55	7.07
55	0	301	394	0	0	0	16	36	38	55	0.00	0.00	0.00	0.00	8.30	42.60	50.52	7.07	7.80
56	0	394	864	0	0	0	16	38	38	56	0.00	0.00	0.00	0.00	8.37	50.52	95.05	7.80	9.09
57	0	864	286	0	0	0	16	38	36	57	0.00	0.00	0.00	0.00	8.07	95.05	41.10	9.09	6.96
58	0	286	681	0	1	0	16	36	37	58	0.00	0.00	0.00	0.00	8.15	41.10	79.11	6.96	8.61
59	0	681	1841	1	5	0	15	37	47	59	0.00	0.00	0.75	0.25	0.00	79.11	157.33	8.61	11.70
60	0	1841	946	5	0	0	10	47	43	60	0.00	0.00	1.81	3.19	0.00	157.33	94.13	117.0	10.05
61	0	946	798	0	1	0	10	43	38	61	0.00	0.00	0.00	0.00	0.00	94.13	88.79	10.05	8.99
62	0	798	1477	1	0	0	9	38	43	62	0.00	0.00	0.68	0.32	0.00	88.79	138.59	8.99	10.66
63	0	1477	982	0	4	0	9	43	43	63	0.00	0.00	0.00	0.00	0.00	138.59	97.14	10.66	10.11
64	0	982	398	4	0	0	5	43	38	64	0.00	0.00	1.25	2.75	-11.61	97 14	50.90	10.11	7.82
65	0	398	739	0	5	0	5	38	43	65	0.00	0.00	0.00	0.00	2.85	50.90	76.80	7.82	9.62
66	1	739	0	5	0	0	0	43	0	66					0.00	76.80	0.00	9.62	0.00

Iteration 1: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1					0.00	0.00	116.45	0.00	8.71
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	116.45	82.33	8.71	9.78
3	0	805	1341	0	0	2	3	43	37	3	0.61	1.39	0.00	0.00	-5.36	82.33	143.32	9.78	9.36
Consolidated	0	393	948	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	1.53	51.09	105.09	7.69	9.02
5	0	1341	755	0	0	0	3	37	37	5	0.00	0.00	0.00	0.00	0.00	143.32	86.31	9.36	8.75
6	0	755	914	0	0	0	3	37	40	6	0.00	0.00	0.00	0.00	0.00	86.31	96.15	8.75	9.51
7	0	914	1281	0	0	0	3	40	43	7	0.00	0.00	0.00	0.00	0.00	96.15	122.18	9.51	10.48
8	0	1281	1394	0	0	1	4	43	23.269	8	0.28	0.72	0.00	0.00	0.00	122.18	220.35	10.48	6.33
Consolidated	0	565	829	0	0	0	4	40	19	9	0.00	0.00	0.00	0.00	1.41	64.74	163.67	8.73	5.07
10	0	1394	414	0	0	3	7	23.269	18	10	0.86	2.14	0.00	0.00	-7.69	220.35	89.05	6.33	4.65
11	0	414	1072	0	2	3	10	18	23	11	2.01	0.99	0.00	0.00	0.00	89.05	175.78	4.65	6.10
12	0	1072	1208	2	0	0	8	23	40.928	12	0.00	0.00	0.86	1.14	0.00	175.78	120.46	6.10	10.03
Consolidated	0	674	534	0	0	0	8	40	42	13	0.00	0.00	0.00	0.00	4.52	74.55	60.35	9.04	8.85
14	0	1208	1439	0	0	0	8	40.928	39.849	14	0.00	0.00	0.00	0.00	0.00	120.46	143.81	10.03	10.01
Consolidated	0	1070	369	0	0	0	8	41	37	15	0.00	0.00	0.00	0.00	4.17	108.19	48.75	9.89	7.57
16	0	1439	1160	0	0	0	8	39.849	36	16	0.00	0.00	0.00	0.00	0.00	143.81	128.50	10.01	9.03
17	0	1160	705	0	0	3	11	36	42	17	1.05	1.95	0.00	0.00	0.00	128.50	75.01	9.03	9.40
18	0	705	1154	0	0	0	11	42	41	18	0.00	0.00	0.00	0.00	0.00	75.01	115.56	9.40	9.99
19	0	1154	1020	0	0	0	11	41	37.7534	19	0.00	0.00	0.00	0.00	0.00	115.56	110.30	9.99	9.25
Consolidated	0	732	288	0	0	0	11	36	43	20	0.00	0.00	0.00	0.00	6.21	85.70	39.04	8.54	7.38
21	0	1020	1272	0	0	0	11	37.754	41.143	21	0.00	0.00	0.00	0.00	6.29	110.30	125.58	9.25	10.13
Consolidated	0	781	491	0	0	0	11	42	40	22	0.00	0.00	0.00	0.00	6.06	81.53	58.08	9.58	8.45
23	0	1272	1036	0	0	0.517	11	41.143	40.861	23	0.00	0.00	0.00	0.00	5.81	125.58	105.40	10.13	9.83
Consolidated	0	465	571	0	0	1	12	38	43	24	0.52	0.48	0.00	0.00	3.16	57.25	62.74	8.12	9.10
25	1	1036	681	0	1	1.483	13	40.861	39	25	0.51	0.49	0.00	0.00	0.00	105.40	76.40	9.83	8.91
26	0	681	1297	1	0	3	15	39	37.733	26	1.08	1.92	0.42	0.58	-5.40	76.40	136.55	8.91	9.50
Consolidated	0	433	864	0	0	0	15	44	36	27	0.00	0.00	0.00	0.00	7.78	50.71	98.90	8.54	8.74
28	0	1297	1110	0	1	0	15	37.733	43	28	0.00	0.00	0.00	0.00	0.00	136.55	107.86	9.50	10.29
29	0	1110	983	1.4115159	1	0	14	43	41.906	29	0.00	0.00	0.38	0.62	0.00	107.86	98.96	10.29	9.93
Consolidated	0	608	375	1	3	0	13	40	45	30	0.00	0.00	0.41	0.59	4.89	68.61	45.63	8.86	8.22
31	0	983	1134	3.5884841	0	3.620	13	41.906	43.486	31	1.44	1.56	1.64	1.36	-8.00	98.96	108.90	9.93	10.41
Consolidated	0	394	740	0	0	1	14	40	45	32	0.62	0.38	0.00	0.00	4.50	49.35	74.83	7.98	9.89
33	0	1134	600	0	2	2.380	16	43.486	12	33	0.84	1.16	0.00	0.00	-1.10	108.90	184.17	10.41	3.26

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
34	1	600	415	2	0	2	16	12	16.506	34	0.45	1.55	0.74	1.26	0.00	184.17	96.11	3.26	4.32
Consolidated	0	249	166	0	0	0	16	19	14	35	0.00	0.00	0.00	0.00	4.11	53.78	47.55	4.63	3.49
36	0	415	454	0.399	1	4	20	16.506	16.285	36	2.26	1.74	0.00	0.00	-0.69	96.11	105.84	4.32	4.29
Consolidated	0	298	156	1	0	0	19	19	13	37	0.00	0.00	0.40	0.60	3.35	63.06	47.71	4.73	3.27
38	1	454	357	0.601	6	1	20	16.285	20	38	0.62	0.38	0.00	0.00	0.00	105.84	71.20	4.29	5.01
39	1	357	1605	6	1	14	28	20	24	39	10.96	3.04	5.09	0.91	0.00	71.20	249.08	5.01	6.44
40	0	1605	628	1	0	1	28	24	17.973	40	0.10	0.90	0.13	0.87	0.00	249.08	131.97	6.44	4.76
Consolidated	0	203	425	0	0	0	28	16	19	41	0.00	0.00	0.00	0.00	8.30	51.23	87.12	3.96	4.88
42	0	628	1178	0	0	0.491	28	17.973	29.003	42	0.00	0.00	0.00	0.00	9.53	131.97	155.79	4.76	7.56
Consolidated	0	544	634	0	1	1	29	23	37	43	0.49	0.51	0.00	0.00	9.75	93.13	74.53	5.84	8.51
44	1	1178	1046	1	0	4.509	32	29.003	42	44	2.37	1.63	0.65	0.35	0.00	155.79	104.24	7.56	10.03
45	0	1046	549	0	0	0	32	42	42	45	0.00	0.00	0.00	0.00	0.00	104.24	61.64	10.03	8.91
46	0	549	1313	0.164	1	0	32	42	40.902	46	0.00	0.00	0.00	0.00	0.00	61.64	129.67	8.91	10.13
Consolidated	0	1117	196	1	5	0	31	40	48	47	0.00	0.00	0.16	0.84	17.02	114.42	31.37	9.76	6.25
48	0	1313	1141	7.135	3	4	30	40.902	43.500	48	2.97	1.03	4.03	0.97	0.66	129.67	109.44	10.13	10.43
Consolidated	0	678	463	3	2	0	27	47	40	49	0.00	0.00	1.30	1.70	5.05	68.25	55.56	9.93	8.33
50	0	1141	1445	4.591	2	0	25	43.500	38.343	50	0.00	0.00	1.35	0.65	5.60	109.44	148.85	10.43	9.71
Consolidated	0	848	597	2	4	0	23	35	44	51	0.00	0.00	0.89	1.11	4.90	99.38	64.12	8.53	9.31
52	0	1445	1188	5.759	1	0	19	38.343	38.798	52	0.00	0.00	1.84	2.16	-0.18	148.85	122.95	9.71	9.66
Consolidated	0	451	737	1	2	0	18	49	36	53	0.00	0.00	0.65	0.35	6.26	50.15	86.20	8.99	8.55
54	0	1188	695	2.351	0	0	16	38.798	37.266	54	0.00	0.00	0.63	1.37	2.65	122.95	80.07	9.66	8.68
55	0	301	394	0	0	0	16	36	38	55	0.00	0.00	0.00	0.00	8.30	42.60	50.52	7.07	7.80
Consolidated	0	695	1150	0	0	0	16	37.266	37.464	56	0.00	0.00	0.00	0.00	8.37	80.07	123.51	8.68	9.31
57	0	864	286	0	0	0	16	38	36	57	0.00	0.00	0.00	0.00	8.07	95.05	41.10	9.09	6.96
Consolidated	0	1150	681	0	1	0	16	37.464	37	58	0.00	0.00	0.00	0.00	8.15	123.51	79.11	9.31	8.61
59	0	681	1841	1	5	0	15	37	47	59	0.00	0.00	0.75	0.25	0.00	79.11	157.33	8.61	11.70
60	0	1841	946	5	0	0	10	47	43	60	0.00	0.00	1.81	3.19	0.00	157.33	94.13	11.70	10.05
61	0	946	798	0	1	0	10	43	38	61	0.00	0.00	0.00	0.00	0.00	94.13	88.79	10.05	8.99
62	0	798	1477	1	0	0	9	38	43	62	0.00	0.00	0.68	0.32	0.00	88.79	138.59	8.99	10.66
63	0	1477	982	0	4	0	9	43	43	63	0.00	0.00	0.00	0.00	0.00	138.59	97.14	10.66	10.11
64	0	982	1137	4	0	0	5	43	41.422	64	0.00	0.00	1.25	2.75	-11.61	97.14	113.12	10.11	10.05
Consolidated	0	398	739	0	5	0	5	38	43	65	0.00	0.00	0.00	0.00	2.85	50.90	76.80	7.82	9.62
66	1	1137	0	5	0	0	0	41.422	0	66					0.00	113.12	0.00	10.05	0.00

Final Update in Iteration 1 or Primary Data Table for iteration 2

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	805	1341	0	0	2	3	43	37	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	1341	755	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	755	914	0	0	0	3	37	40	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	914	1281	0	0	0	3	40	43	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0	1281	1394	0	0	1	4	43	23	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	1394	414	0	0	3	7	23	18	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0	414	1072	0	2	3	10	18	23	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	1072	1208	2	0	0	8	23	41	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	1208	1439	0	0	0	8	41	40	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0	1439	1160	0	0	0	8	40	36	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	1160	705	0	0	3	11	36	42	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0	705	1154	0	0	0	11	42	41	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	1154	1020	0	0	0	11	41	38	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0	1020	1272	0	0	0	11	38	41	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0	1272	1036	0	0	1	12	41	41	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1	1036	681	0	1	1	13	41	39	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0	681	1297	1	0	3	15	39	38	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0	1297	1110	0	1	0	15	38	43	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0	1110	983	1	4	0	14	43	42	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0	983	1134	4	0	4	14	42	43	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0	1134	600	0	2	2	16	43	12	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	1	600	415	2	0	2	16	12	17	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0	415	454	0	1	4	20	17	16	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	1	454	357	1	6	1	20	16	20	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	1	357	1605	6	1	14	28	20	24	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0	1605	628	1	0	1	28	24	18	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0	628	1178	0	1	0	28	18	29	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	1	1178	1046	1	0	5	32	29	42	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0	1046	549	0	0	0	32	42	42	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0	549	1313	0	7	0	32	42	41	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0	1313	1141	7	5	4	29	41	43	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0	1445	1188	6	2	0	18	38	39	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0	1188	301	2	0	0	16	39	36	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0	301	1258	0	0	0	16	36	38	37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0	1258	967	0	1	0	16	38	37	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	0	967	1841	1	5	0	15	37	47	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	0	1841	946	5	0	0	10	47	43	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
61	0	946	798	0	1	0	10	43	38	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62	0	798	1477	1	0	0	9	38	43	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	0	1477	982	0	4	0	9	43	43	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64	0	982	1137	4	5	0	5	43	41	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66	1	1137	0	5	0	0	0	41	0	45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 2: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1	0.00	0.00	0.00	0.00	0.00	0.00	116.45	0.00	8.71
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	116.45	82.33	8.71	9.78
3	0	805	1341	0	0	2	3	43	37	3	1.20	0.80	0.00	0.00	0.00	82.33	143.32	9.78	9.36
5	0	1341	755	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	0.00	143.32	86.31	9.36	8.75
6	0	755	914	0	0	0	3	37	40	5	0.00	0.00	0.00	0.00	0.00	86.31	96.15	8.75	9.51
7	0	914	1281	0	0	0	3	40	43	6	0.00	0.00	0.00	0.00	0.00	96.15	122.18	9.51	10.48
8	0	1281	1394	0	0	1	4	43	23	7	0.49	0.51	0.00	0.00	0.00	122.18	226.18	10.48	6.16
10	0	1394	414	0	0	3	7	23	18	8	0.60	2.40	0.00	0.00	0.00	226.18	89.05	6.16	4.65
11	0	414	1072	0	2	3	10	18	23	9	2.01	0.99	0.00	0.00	0.00	89.05	175.78	4.65	6.10
12	0	1072	1208	2	0	0	8	23	41	10	0.00	0.00	1.15	0.85	0.00	175.78	120.30	6.10	10.04
14	0	1208	1439	0	0	0	8	41	40	11	0.00	0.00	0.00	0.00	0.00	120.30	143.40	10.04	10.03
16	0	1439	1160	0	0	0	8	40	36	12	0.00	0.00	0.00	0.00	0.00	143.40	128.50	10.03	9.03
17	0	1160	705	0	0	3	11	36	42	13	1.05	1.95	0.00	0.00	0.00	128.50	75.01	9.03	9.40
18	0	705	1154	0	0	0	11	42	41	14	0.00	0.00	0.00	0.00	0.00	75.01	115.56	9.40	9.99
19	0	1154	1020	0	0	0	11	41	38	15	0.00	0.00	0.00	0.00	0.00	115.56	109.83	9.99	9.29
21	0	1020	1272	0	0	0	11	38	41	16	0.00	0.00	0.00	0.00	0.00	109.83	125.92	9.29	10.10
23	0	1272	1036	0	0	1	12	41	41	17	0.42	0.58	0.00	0.00	0.00	125.92	105.20	10.10	9.85
25	1	1036	681	0	1	1	13	41	39	18	0.37	0.63	0.00	0.00	0.00	105.20	76.40	9.85	8.91
26	0	681	1297	1	0	3	15	39	38	19	1.88	1.12	0.68	0.32	0.00	76.40	136.07	8.91	9.53
28	0	1297	1110	0	1	0	15	38	43	20	0.00	0.00	0.00	0.00	0.00	136.07	107.86	9.53	10.29
29	0	1110	983	1	4	0	14	43	42	21	0.00	0.00	0.50	0.50	0.00	107.86	98.84	10.29	9.95
31	0	983	1134	4	0	4	14	42	43	22	2.03	1.97	2.25	1.75	0.00	98.84	109.87	9.95	10.32
33	0	1134	600	0	2	2	16	43	12	23	0.64	1.36	0.00	0.00	0.00	109.87	184.17	10.32	3.26
34	1	600	415	2	0	2	16	12	17	24	0.66	1.34	0.99	1.01	0.00	184.17	93.79	3.26	4.43
36	0	415	454	0	1	4	20	17	16	25	1.84	2.16	0.00	0.00	-5.16	93.79	107.71	4.43	4.22
38	1	454	357	1	6	1	20	16	20	26	0.38	0.62	0.51	0.49	0.00	107.71	71.20	4.22	5.01
39	1	357	1605	6	1	14	28	20	24	27	10.96	3.04	5.09	0.91	0.00	71.20	249.08	5.01	6.44
40	0	1605	628	1	0	1	28	24	18	28	0.25	0.75	0.32	0.68	0.00	249.08	131.85	6.44	4.76
42	0	628	1178	0	1	0	28	18	29	29	0.00	0.00	0.00	0.00	0.00	131.85	156.30	4.76	7.54
44	1	1178	1046	1	0	5	32	29	42	30	2.17	2.83	0.51	0.49	0.00	156.30	104.24	7.54	10.03
45	0	1046	549	0	0	0	32	42	42	31	0.00	0.00	0.00	0.00	0.00	104.24	61.64	10.03	8.91
46	0	549	1313	0	7	0	32	42	41	32	0.00	0.00	0.00	0.00	0.00	61.64	129.52	8.91	10.14
48	0	1313	1141	7	5	4	29	41	43	33	1.75	2.25	3.45	3.55	0.00	129.52	110.46	10.14	10.33

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	2.93	2.07	0.00	110.46	150.09	10.33	9.63
52	0	1445	1188	6	2	0	18	38	39	35	0.00	0.00	2.88	3.12	0.00	150.09	123.20	9.63	9.64
54	0	1188	301	2	0	0	16	39	36	36	0.00	0.00	0.44	1.56	1.93	123.20	42.60	9.64	7.07
55	0	301	1258	0	0	0	16	36	38	37	0.00	0.00	0.00	0.00	0.00	42.60	132.37	7.07	9.50
57	0	1258	967	0	1	0	16	38	37	38	0.00	0.00	0.00	0.00	0.00	132.37	106.93	9.50	9.04
59	0	967	1841	1	5	0	15	37	47	39	0.00	0.00	0.68	0.32	0.00	106.93	157.33	9.04	11.70
60	0	1841	946	5	0	0	10	47	43	40	0.00	0.00	1.81	3.19	0.00	157.33	94.13	11.70	10.05
61	0	946	798	0	1	0	10	43	38	41	0.00	0.00	0.00	0.00	0.00	94.13	88.79	10.05	8.99
62	0	798	1477	1	0	0	9	38	43	42	0.00	0.00	0.68	0.32	0.00	88.79	138.59	8.99	10.66
63	0	1477	982	0	4	0	9	43	43	43	0.00	0.00	0.00	0.00	0.00	138.59	97.14	10.66	10.11
64	0	982	1137	4	5	0	5	43	41	44	0.00	0.00	2.26	1.74	0.00	97.14	114.07	10.11	9.97
66	1	1137	0	5	0	0	0	41	0	45	0.00	0.00	0.00	0.00	0.00	114.07	0.00	9.97	0.00

Iteration 2: Update after Consolidation

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1	0.00	0.00	0.00	0.00	0.00	0.00	116.45	0.00	8.71
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	116.45	82.33	8.71	9.78
3	0	805	1341	0	0	2	3	43	37	3	1.20	0.80	0.00	0.00	0.00	82.33	143.32	9.78	9.36
5	0	1341	755	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	0.00	143.32	86.31	9.36	8.75
6	0	755	914	0	0	0	3	37	40	5	0.00	0.00	0.00	0.00	0.00	86.31	96.15	8.75	9.51
7	0	914	1281	0	0	0	3	40	43	6	0.00	0.00	0.00	0.00	0.00	96.15	122.18	9.51	10.48
8	0	1281	1394	0	0	1	4	43	23	7	0.49	0.51	0.00	0.00	0.00	122.18	226.18	10.48	6.16
10	0	1394	414	0	0	3	7	23	18	8	0.60	2.40	0.00	0.00	0.00	226.18	89.05	6.16	4.65
11	0	414	1072	0	2	3	10	18	23	9	2.01	0.99	0.00	0.00	0.00	89.05	175.78	4.65	6.10
12	0	1072	1208	2	0	0	8	23	41	10	0.00	0.00	1.15	0.85	0.00	175.78	120.30	6.10	10.04
14	0	1208	1439	0	0	0	8	41	40	11	0.00	0.00	0.00	0.00	0.00	120.30	143.40	10.04	10.03
16	0	1439	1160	0	0	0	8	40	36	12	0.00	0.00	0.00	0.00	0.00	143.40	128.50	10.03	9.03
17	0	1160	705	0	0	3	11	36	42	13	1.05	1.95	0.00	0.00	0.00	128.50	75.01	9.03	9.40
18	0	705	1154	0	0	0	11	42	41	14	0.00	0.00	0.00	0.00	0.00	75.01	115.56	9.40	9.99
19	0	1154	1020	0	0	0	11	41	38	15	0.00	0.00	0.00	0.00	0.00	115.56	109.83	9.99	9.29
21	0	1020	1272	0	0	0	11	38	41	16	0.00	0.00	0.00	0.00	0.00	109.83	125.92	9.29	10.10
23	0	1272	1036	0	0	1	12	41	41	17	0.42	0.58	0.00	0.00	0.00	125.92	105.20	10.10	9.85
25	1	1036	681	0	1	1	13	41	39	18	0.37	0.63	0.00	0.00	0.00	105.20	76.40	9.85	8.91
26	0	681	1297	1	0	3	15	39	38	19	1.88	1.12	0.68	0.32	0.00	76.40	136.07	8.91	9.53
28	0	1297	1110	0	1	0	15	38	43	20	0.00	0.00	0.00	0.00	0.00	136.07	107.86	9.53	10.29
29	0	1110	983	1	4	0	14	43	42	21	0.00	0.00	0.50	0.50	0.00	107.86	98.84	10.29	9.95
31	0	983	1134	4	0	4	14	42	43	22	2.03	1.97	2.25	1.75	0.00	98.84	109.87	9.95	10.32
33	0	1134	600	0	2	2	16	43	12	23	0.64	1.36	0.00	0.00	0.00	109.87	184.17	10.32	3.26
34	1	600	415	2	0	2	16	12	17	24	0.66	1.34	0.99	1.01	0.00	184.17	93.79	3.26	4.43
36	0	415	454	0	1	4	20	17	16	25	1.84	2.16	0.00	0.00	-5.16	93.79	107.71	4.43	4.22
38	1	454	357	1	6	1	20	16	20	26	0.38	0.62	0.51	0.49	0.00	107.71	71.20	4.22	5.01
39	1	357	1605	6	1	14	28	20	24	27	10.96	3.04	5.09	0.91	0.00	71.20	249.08	5.01	6.44
40	0	1605	628	1	0	1	28	24	18	28	0.25	0.75	0.32	0.68	0.00	249.08	131.85	6.44	4.76
42	0	628	1178	0	1	0	28	18	29	29	0.00	0.00	0.00	0.00	0.00	131.85	156.30	4.76	7.54
44	1	1178	1046	1	0	5	32	29	42	30	2.17	2.83	0.51	0.49	0.00	156.30	104.24	7.54	10.03
45	0	1046	549	0	0	0	32	42	42	31	0.00	0.00	0.00	0.00	0.00	104.24	61.64	10.03	8.91
46	0	549	1313	0	7	0	32	42	41	32	0.00	0.00	0.00	0.00	0.00	61.64	129.52	8.91	10.14
48	0	1313	1141	7	5	4	29	41	43	33	1.75	2.25	3.45	3.55	0.00	129.52	110.46	10.14	10.33

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	2.93	2.07	0.00	110.46	150.09	10.33	9.63
52	0	1445	1489	6.4427887	2	0	18	38	38.345083	35	0.00	0.00	2.88	3.12	0.00	150.09	153.09	9.63	9.73
Consolidated	0	1188	301	2	0	0	16	39	36	36	0.00	0.00	0.44	1.56	1.93	123.20	42.60	9.64	7.07
55	0	1489	1258	1.5572113	0	0	16	38.345083	38	37	0.00	0.00	0.00	0.00	0.00	153.09	132.37	9.73	9.50
57	0	1258	967	0	1	0	16	38	37	38	0.00	0.00	0.00	0.00	0.00	132.37	106.93	9.50	9.04
59	0	967	1841	1	5	0	15	37	47	39	0.00	0.00	0.68	0.32	0.00	106.93	157.33	9.04	11.70
60	0	1841	946	5	0	0	10	47	43	40	0.00	0.00	1.81	3.19	0.00	157.33	94.13	11.70	10.05
61	0	946	798	0	1	0	10	43	38	41	0.00	0.00	0.00	0.00	0.00	94.13	88.79	10.05	8.99
62	0	798	1477	1	0	0	9	38	43	42	0.00	0.00	0.68	0.32	0.00	88.79	138.59	8.99	10.66
63	0	1477	982	0	4	0	9	43	43	43	0.00	0.00	0.00	0.00	0.00	138.59	97.14	10.66	10.11
64	0	982	1137	4	5	0	5	43	41	44	0.00	0.00	2.26	1.74	0.00	97.14	114.07	10.11	9.97
66	1	1137	0	5	0	0	0	41	0	45	0.00	0.00	0.00	0.00	0.00	114.07	0.00	9.97	0.00

Final Update In Iteration 2 or Primary Data Table for Iteration 3

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0	805	1341	0	0	2	3	43	37	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	1341	755	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	755	914	0	0	0	3	37	40	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0	914	1281	0	0	0	3	40	43	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0	1281	1394	0	0	1	4	43	23	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	1394	414	0	0	3	7	23	18	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0	414	1072	0	2	3	10	18	23	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	1072	1208	2	0	0	8	23	41	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	1208	1439	0	0	0	8	41	40	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0	1439	1160	0	0	0	8	40	36	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	1160	705	0	0	3	11	36	42	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0	705	1154	0	0	0	11	42	41	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	1154	1020	0	0	0	11	41	38	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0	1020	1272	0	0	0	11	38	41	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0	1272	1036	0	0	1	12	41	41	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1	1036	681	0	1	1	13	41	39	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0	681	1297	1	0	3	15	39	38	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0	1297	1110	0	1	0	15	38	43	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0	1110	983	1	4	0	14	43	42	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0	983	1134	4	0	4	14	42	43	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0	1134	600	0	2	2	16	43	12	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	1	600	415	2	0	2	16	12	17	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0	415	454	0	1	4	20	17	16	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	1	454	357	1	6	1	20	16	20	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	1	357	1605	6	1	14	28	20	24	27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0	1605	628	1	0	1	28	24	18	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0	628	1178	0	1	0	28	18	29	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	1	1178	1046	1	0	5	32	29	42	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0	1046	549	0	0	0	32	42	42	31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0	549	1313	0	7	0	32	42	41	32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0	1313	1141	7	5	4	29	41	43	33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0	1445	1489	6	2	0	18	38	38	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0	1489	1258	2	0	0	16	38	38	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0	1258	967	0	1	0	16	38	37	37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	0	967	1841	1	5	0	15	37	47	38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	0	1841	946	5	0	0	10	47	43	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
61	0	946	798	0	1	0	10	43	38	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62	0	798	1477	1	0	0	9	38	43	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	0	1477	982	0	4	0	9	43	43	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64	0	982	1137	4	5	0	5	43	41	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66	1	1137	0	5	0	0	0	41	0	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Iteration 3: Complete Data Table

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
1	1	0	1014	0	0	1	1	0	35	1	0.00	0.00	0.00	0.00	0.00	0.00	116.45	0.00	8.71
2	0	1014	805	0	0	0	1	35	43	2	0.00	0.00	0.00	0.00	0.00	116.45	82.33	8.71	9.78
3	0	805	1341	0	0	2	3	43	37	3	1.20	0.80	0.00	0.00	0.00	82.33	143.32	9.78	9.36
5	0	1341	755	0	0	0	3	37	37	4	0.00	0.00	0.00	0.00	0.00	143.32	86.31	9.36	8.75
6	0	755	914	0	0	0	3	37	40	5	0.00	0.00	0.00	0.00	0.00	86.31	96.15	8.75	9.51
7	0	914	1281	0	0	0	3	40	43	6	0.00	0.00	0.00	0.00	0.00	96.15	122.18	9.51	10.48
8	0	1281	1394	0	0	1	4	43	23	7	0.49	0.51	0.00	0.00	0.00	122.18	226.18	10.48	6.16
10	0	1394	414	0	0	3	7	23	18	8	0.60	2.40	0.00	0.00	0.00	226.18	89.05	6.16	4.65
11	0	414	1072	0	2	3	10	18	23	9	2.01	0.99	0.00	0.00	0.00	89.05	175.78	4.65	6.10
12	0	1072	1208	2	0	0	8	23	41	10	0.00	0.00	1.15	0.85	0.00	175.78	120.30	6.10	10.04
14	0	1208	1439	0	0	0	8	41	40	11	0.00	0.00	0.00	0.00	0.00	120.30	143.40	10.04	10.03
16	0	1439	1160	0	0	0	8	40	36	12	0.00	0.00	0.00	0.00	0.00	143.40	128.50	10.03	9.03
17	0	1160	705	0	0	3	11	36	42	13	1.05	1.95	0.00	0.00	0.00	128.50	75.01	9.03	9.40
18	0	705	1154	0	0	0	11	42	41	14	0.00	0.00	0.00	0.00	0.00	75.01	115.56	9.40	9.99
19	0	1154	1020	0	0	0	11	41	38	15	0.00	0.00	0.00	0.00	0.00	115.56	109.83	9.99	9.29
21	0	1020	1272	0	0	0	11	38	41	16	0.00	0.00	0.00	0.00	0.00	109.83	125.92	9.29	10.10
23	0	1272	1036	0	0	1	12	41	41	17	0.42	0.58	0.00	0.00	0.00	125.92	105.20	10.10	9.85
25	1	1036	681	0	1	1	13	41	39	18	0.37	0.63	0.00	0.00	0.00	105.20	76.40	9.85	8.91
26	0	681	1297	1	0	3	15	39	38	19	1.88	1.12	0.68	0.32	0.00	76.40	136.07	8.91	9.53
28	0	1297	1110	0	1	0	15	38	43	20	0.00	0.00	0.00	0.00	0.00	136.07	107.86	9.53	10.29
29	0	1110	983	1	4	0	14	43	42	21	0.00	0.00	0.50	0.50	0.00	107.86	98.84	10.29	9.95
31	0	983	1134	4	0	4	14	42	43	22	2.03	1.97	2.25	1.75	0.00	98.84	109.87	9.95	10.32
33	0	1134	600	0	2	2	16	43	12	23	0.64	1.36	0.00	0.00	0.00	109.87	184.17	10.32	3.26
34	1	600	415	2	0	2	16	12	17	24	0.66	1.34	0.99	1.01	0.00	184.17	93.79	3.26	4.43
36	0	415	454	0	1	4	20	17	16	25	1.84	2.16	0.00	0.00	-5.16	93.79	107.71	4.43	4.22
38	1	454	357	1	6	1	20	16	20	26	0.38	0.62	0.51	0.49	0.00	107.71	71.20	4.22	5.01
39	1	357	1605	6	1	14	28	20	24	27	10.96	3.04	5.09	0.91	0.00	71.20	249.08	5.01	6.44
40	0	1605	628	1	0	1	28	24	18	28	0.25	0.75	0.32	0.68	0.00	249.08	131.85	6.44	4.76
42	0	628	1178	0	1	0	28	18	29	29	0.00	0.00	0.00	0.00	0.00	131.85	156.30	4.76	7.54
44	1	1178	1046	1	0	5	32	29	42	30	2.17	2.83	0.51	0.49	0.00	156.30	104.24	7.54	10.03
45	0	1046	549	0	0	0	32	42	42	31	0.00	0.00	0.00	0.00	0.00	104.24	61.64	10.03	8.91
46	0	549	1313	0	7	0	32	42	41	32	0.00	0.00	0.00	0.00	0.00	61.64	129.52	8.91	10.14
48	0	1313	1141	7	5	4	29	41	43	33	1.75	2.25	3.45	3.55	0.00	129.52	110.46	10.14	10.33

Original Stop Number	Transfer Stop	Distance from Preceding Stop (meters)	Distance from Subsequent Stop (meters)	Number of Alighting Passengers	Number of Alighting Passengers at Subsequent Stop	Number of Boarding Passengers	Number of On-board Passengers	Cruising Speed along the Preceding Link section (km/hr)	Cruising Speed along the Subsequent Link section (km/hr)	Current Stop Number	Boarding passengers at the preceding stop after consolidation	Boarding passengers at the subsequent stop after consolidation	Alighting passengers at the preceding stop after consolidation	Alighting passengers at the subsequent stop after consolidation	Travel Time Savings (minute)	Cruising time on preceding link (seconds)	Cruising time on subsequent link (seconds)	Average speed on preceding link (meters/second)	Average speed on subsequent link (meters/second)
50	0	1141	1445	5	6	0	24	43	38	34	0.00	0.00	2.93	2.07	0.00	110.46	150.09	10.33	9.63
52	0	1445	1489	6	2	0	18	38	38	35	0.00	0.00	3.22	2.78	0.00	150.09	154.26	9.63	9.65
55	0	1489	1258	2	0	0	16	38	38	36	0.00	0.00	0.97	1.03	0.00	154.26	132.37	9.65	9.50
57	0	1258	967	0	1	0	16	38	37	37	0.00	0.00	0.00	0.00	0.00	132.37	106.93	9.50	9.04
59	0	967	1841	1	5	0	15	37	47	38	0.00	0.00	0.68	0.32	0.00	106.93	157.33	9.04	11.70
60	0	1841	946	5	0	0	10	47	43	39	0.00	0.00	1.81	3.19	0.00	157.33	94.13	11.70	10.05
61	0	946	798	0	1	0	10	43	38	40	0.00	0.00	0.00	0.00	0.00	94.13	88.79	10.05	8.99
62	0	798	1477	1	0	0	9	38	43	41	0.00	0.00	0.68	0.32	0.00	88.79	138.59	8.99	10.66
63	0	1477	982	0	4	0	9	43	43	42	0.00	0.00	0.00	0.00	0.00	138.59	97.14	10.66	10.11
64	0	982	1137	4	5	0	5	43	41	43	0.00	0.00	2.26	1.74	0.00	97.14	114.07	10.11	9.97
66	1	1137	0	5	0	0	0	41	0	44	0.00	0.00	0.00	0.00	0.00	114.07	0.00	9.97	0.00

ملخص

هذه الدراسة تطور منهجية ارشادية لدمج أماكن توقف الحافلات، تتضمن هذه الدراسة تطوير نموذج رياضي وبرنامج يساعد في اتخاذ قرار دمج مواقف الحافلات لتحسين زمن الرحلة وإمكانية الوصول لمستخدمي النقل العام. النموذج الرياضي يقوم بإعادة الحل إلى أن تصل مقدر زمن الرحلة إلى حده الأدنى. الدراسة تشمل اختبار النموذج الرياضي على سيناريوهات افتراضية مختلفة، هذه السيناريوهات تشمل ستة عوامل مختلفة بعدة مستويات (المسافة بين أماكن التوقف، سلوكيات المستخدمين، معدل الوقت اللازم لقطع الشارع، الحد الأقصى لمسافة المشي الممكنة، زمن تردد الحافلة، ونسبة انخفاض عدد المستخدمين للحافلة). تم قياس ثلاث أنواع من الاستجابة (نسبة أماكن التوقف التي تم دمجها، نسبة تقليل زمن الرحلة ونسبة تقليل زمن التشغيل). النتائج تشير إلى أن المسافة بين أماكن التوقف و الحد الأقصى لمسافة المشي الممكنة هما العاملان الأكثر تأثيرا، أما سلوكيات المستخدمين و ونسبة انخفاض عدد المستخدمين للحافلة فكانا العاملين الأقل تأثيرا. الدراسة أيضا تناولت التأثير التفاعلي لمختلف العوامل على عوامل الاستجابة المختلفة. في النهاية تم اختبار النموذج الرياضي على اثنين من خطوط خدمة حافلات النقل العام في مدينة العين (900 و 930)، أشارت الدراسة أن 30 و 36 من أماكن التوقف تم دمجها من أصل 98 و 126 في الخطوط 900 و 930 بالترتيب، هذا الدمج يؤدي إلى تقليص كبير في زمن الرحلة للمستخدمين وزمن تشغيل الخدمة، وبالحسابات المادية فإن قيمة التوفير تصل إلى 865,000 و 1,100,000 دولار أمريكي سنويا للخطوط 900 و 930 بالترتيب.

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عنوان الرسالة:

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